# The perception of scale and scale effects in the landscape, with specific reference to wind turbines in Scotland

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## Declaration

*This is to certify that the work contained within this thesis has been composed by me and is entirely my own work. No part of this thesis has been submitted for any other degree or professional qualification.*

Signed: *Caroline Stanton*

November 2016

## Abstract

Perception of scale is important to our activity within a space and to our experience of a landscape. This presents a problem if people cannot predict or convey the scale effects of large structures proposed in a landscape, as has been the case for recent wind turbine proposals in Scotland. To address this problem, this research explored how people perceive scale and scale effects in a landscape. It took wind turbines as an example structure and analysed how different scales of windfarm create different scale effects in different landscapes, as well as how to best assess and communicate these effects.

The research applied three methods to address the research questions: Landscape and Visual Impact Assessment (LVIA), which is a standard, structured process applied by professional landscape architects; experiential landscape assessment, which included semi-structured interviews with local people in addition to site assessment; and public attitude and preference study, which included Adaptive Choice-Based Conjoint analysis (ACBC). These different methods allowed the research questions to be explored in different ways, while overlapping in some aspects and providing triangulation.

The research findings revealed that our perception of scale and scale effects in a landscape is influenced by numerous attributes and depends on how these are experienced together. Building upon the theoretical background, an important difference between visual scale and spatial scale was highlighted, as well as alternative ways in which scale references are made. Throughout the research, the need for clear communication was emphasised and the findings included identifying the specific words that people use to describe scale effects in the most discriminating way.

This research supported other studies in finding that consultation with local people (professionals and the public) was vital to understand in sufficient depth how a landscape was perceived, experienced and valued. In addition, the innovative development of Conjoint Analysis demonstrated how this method can reveal how people judge the relative importance of different attributes that influence landscape and visual effects and, by doing so, offer new possibilities as a tool in landscape research.

Building upon the general findings concerning scale, specific findings regarding the scale effects of windfarms included: greater influence of the proximity of a windfarm than size or numbers of wind turbines; greater importance for being in private and/or fixed locations that offer a sense of refuge compared to public locations and/or when moving; the importance of collective effects perceived and experienced by a community; the importance of perceived spatial separation between a viewer and a windfarm (affecting sensitivity to scale effects within open settings); and differences in how people judge the importance of horizontal scale effects compared to vertical scale effects.

The research findings contribute to the knowledge and understanding of people's perception of scale and scale effects in a landscape and they counter some common assumptions and current practice in landscape architecture. They can be applied in practice and policy to help assess scale effects, convey more clearly to people the type of scale effects and how these will affect them, and minimise the adverse scale effects of windfarms through siting and design. The thesis also identifies how to build upon these findings in the future, including recommendations for additional research, new approaches to assessment (including the use of prompt lists) and thresholds for acceptability of scale effects.

## Acknowledgements

I am very grateful to a large number of people that have helped me with this research, particularly Professor Catharine Ward Thompson and Emeritus Professor Peter Aspinall for their continued support, guidance and patience.  In addition, I would like to convey my thanks to Dr Simon Bell and my fellow students, especially Deborah Reid and Francisca Lima.

A number of people to whom I am very grateful have not just assisted me with this research, but have long-supported my work as a landscape architect and desire to explore new aspects of the Scottish landscape.  These include Frances Thin, Simon Brooks, Nigel Buchan, Fraser Mackenzie, Roger McMichael and past colleagues at horner + maclennan landscape architects and Scottish Natural Heritage.  I would also like to express particular thanks to Janet Swailes, who has always encouraged me greatly in my work over many years and whilst traipsing over a wide range of landscapes.

It would not have been possible to carry out this research without the participation of local people within my case study areas and I would like to thank them all for meeting me, giving their time and sharing their experiences of the landscape.  I would like to convey particular thanks to Hilda Hesling, not just for providing information and support, but for her incredible insight of the Druim Ba landscape and people.

I am indebted to Sawtooth Software Inc who provided the Conjoint Analysis software for this research on an academic grant.

Finally, I would like to thank my family for their incredible support, particularly Duncan and Jonathan.  Perhaps we can now reduce the frequency of the teasing response: ‘well, it probably depends on the scale’!

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## Thesis structure

This thesis is divided into four sections:

- **Section A** sets out the background to the research and reviews and analyses the theory on which it builds, leading to the identification of research questions and hypotheses;
- **Section B** describes the overall research strategy and methodology developed to address the research questions in addition to the three separate methods of Landscape and Visual Impact Assessment (LVIA), experiential landscape assessment and public attitude and preference study;
- **Section C** describes the research findings and interpretation of the three main methods; and
- **Section D** draws together all the research findings and reviews these in relation to the problem statement and the research questions and hypotheses, followed by analysis of how these findings can be applied in practice and policy. This section also reflects on how the research contributes to knowledge and understanding in its field and draws final conclusions.

The contents of the individual thesis chapters are summarised below.

### *Section A: Research background and theoretical background*

#### Chapter 1: Research background and problem statement

This chapter highlights how scale is very important to our experience of the landscape. It describes the problems people encounter when predicting or conveying the scale effects of large structures proposed in a landscape and explains why it is important to address these problems. It describes the use of wind turbines to research scale effects in the landscape and also defines some key terms used in the thesis.

#### Chapter 2: Theoretical background

In this chapter, there is critical review and analysis of the literature that forms the theoretical background to the research. This includes analysis of what is meant by scale and how people perceive this in different ways. Thresholds for being 'in scale' or 'out of scale' are explored in addition to the relevance of concepts such as symbolism. This chapter also reviews application in the past of theories of scale through landscape architecture practice and our understanding of attitudes and preferences to windfarms revealed through recent research.

## *Section B: Research strategy and methodology*

### Chapter 3: Methodology framework

This chapter describes the framework of research developed to address the problem statement and research questions, including application of three different methods and study of three different case studies. Some key limitations and exclusions for the methods are also explained in addition to the role of consultation throughout the research process.

### Chapter 4: Individual research methods

The three main methods used for this research are described in detail within this chapter: Landscape and Visual Impact Assessment (LVIA); experiential landscape assessment; and public attitude and preference study. It is explained within the chapter how each of the methods were developed to address the research questions and include various processes such as critical review, site assessment, semi-structured interviews, questionnaires and data analyses.

## *Section C: Research findings and interpretation*

### Chapter 5: Landscape and Visual Impact Assessment (LVIA): Research findings and interpretation

This chapter describes the findings of LVIA analyses. This includes: review of the Guidelines for Landscape and Visual Impact Assessment (GLVIA); review of LVIA reports produced in the past; site assessment of broad level scale effects of a range of operational windfarms; and detail assessment of the scale effects of proposed or existing windfarms within the case study areas. This allows comparison between the scope of LVIA to consider scale effects, how LVIA is typically undertaken in practice to assess scale effects and, where insufficient, what LVIA needs to include to assess fully the scale effects of a windfarm.

### Chapter 6: Experiential landscape assessment: Research findings and interpretation

This chapter describes the findings of the experiential landscape assessment method following assessment on site and consultation with professionals and members of the public within the three case study areas. The findings are categorised into themes reflecting combinations of landscape characteristics and how these are experienced and valued by people.

### Chapter 7: Public attitude and preference study: Research findings and interpretation

Within this chapter, the findings of two public attitude and preference studies are described. The findings of the first questionnaire reveal which words are selected by people to describe scale effects and which are used in the most discriminating way. The findings of the second questionnaire, an Adaptive Choice-Based Conjoint (ACBC) analysis, reveal the relative importance of key attributes influencing people's perception of scale effect.

## *Section D: Research review, application and conclusions*

### Chapter 8: Review of the research findings, consideration of their application and conclusions

This chapter reviews the findings of the research in relation to the theoretical background and describes how these findings address the separate research questions and confirm the hypotheses. The limitations of the research are described together with opportunities for further research and development. The chapter explains how the research findings can be applied in practice and policy and their contribution to knowledge and understanding. Finally, the chapter describes the main conclusions of the research.

## *References*

## *Appendices*

Separate appendices supporting each of the individual chapters are included after the main thesis report.

# Section A: Research background and theoretical background

## Chapter 1
## RESEARCH BACKGROUND AND PROBLEM STATEMENT

Scale is important to us all in our everyday life, from estimating how high to step over an obstacle, to judging the distance of a person or building.

The scale upon which we focus changes in relation to what interests us. In addition, our experience of scale in the landscape changes in response to spatial qualities, for example from feeling exposed and 'on the top of the world', to feeling harboured by the intimacy of a woodland, town square or coastal inlet. In these ways, the scale of our surroundings influences our sense of well-being (Vroom, 2006).

Figure 1.1: Examples of different influences on our experience of scale in the landscape

Landscape architects are concerned with scale relationships in three main ways:

- The scale of spaces in relation to other spaces and specific elements within these;
- The scale of elements in relation to other elements or parts of elements and the surrounding landscape; and
- The scale of elements and spaces in relation to the people experiencing them.

### 1.1 Problems with perceiving scale and scale effects in a landscape

Accepting that scale is important to people's experience of a landscape, this research was prompted by identification of the following problem:

*Problem statement:*
That people find it difficult to predict and convey the scale effects of large structures proposed in a landscape.

This problem is particularly important because the scale effects of large structures are often judged as being negative.

To examine the paradigm of scale effect in the landscape, this research considered windfarms[1] as a development type. These offered a number of advantages for examining perception of scale and scale effects in Scotland, namely:

a Wind turbines are structures that are widely developed in Scotland and further afield, so there were many examples of existing and proposed developments which the research could study, including before and after construction;

b Wind turbines are commonly available in all sizes from about 12m to 200m to blade tip[2], yet possess a consistency of form lacked by other built elements (and thus variables could be limited to their scale);

c Wind turbines have been and continue to be located in many different landscape types within Scotland and thus could be assessed within different contexts of landscape type and experience; and

d There is a lot of interest in the development of windfarms within Scotland and further afield which facilitated liaison and engagement with members of the public and professionals regarding the research.

The following section describes the main reasons behind the research problem statement with specific reference to wind turbines in Scotland.

### *1.1 A difficulty to predict and convey the scale and scale effects of proposed wind turbines*

It is difficult to estimate size and distance within a landscape based upon dimensions (Adler, Brittain-Catlin and Fontana-Giusti, 2012; Rogers, 1995) and this includes the size and distance of windfarms. To understand further the scope of this problem, given very little

[1] For this research, this term is used to describe one or more wind turbines developed as a single scheme (see 3.3 for further details).
[2] 'To blade tip' is a term for size used in the wind energy industry to mean the dimension of a wind turbine from the base of its tower to the tip of the wind turbine blades when pointing upwards.

published literature on the subject, this research involved an early, exploratory survey to get a sense of how well or poorly people are able to link actual dimensions and distances of windfarms to a perception of scale effect. This involved carrying out a survey at a visitor centre where there are views of an existing windfarm[3], asking visitors to estimate the size and distances of specific wind turbines which they could see. Figures 1.2 and 1.3 show data obtained from this study which supported even more strongly than expected the problem identified. These revealed that only 22.5% of respondents estimated the height of an existing wind turbine within +/- 20% of its actual height, and only 17.5% and 7.5% of the respondents estimated the near and far distances respectively of existing wind turbines within +/- 20% of the actual distances. Further information on this study is provided in Appendix A.5.

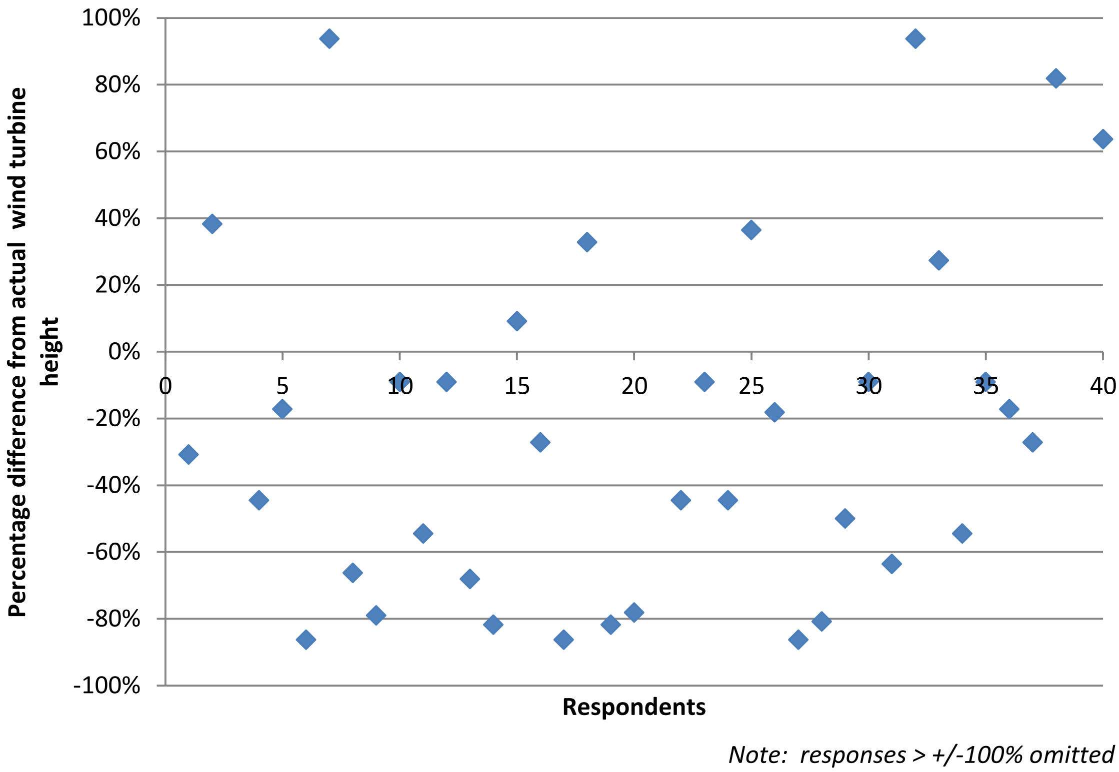
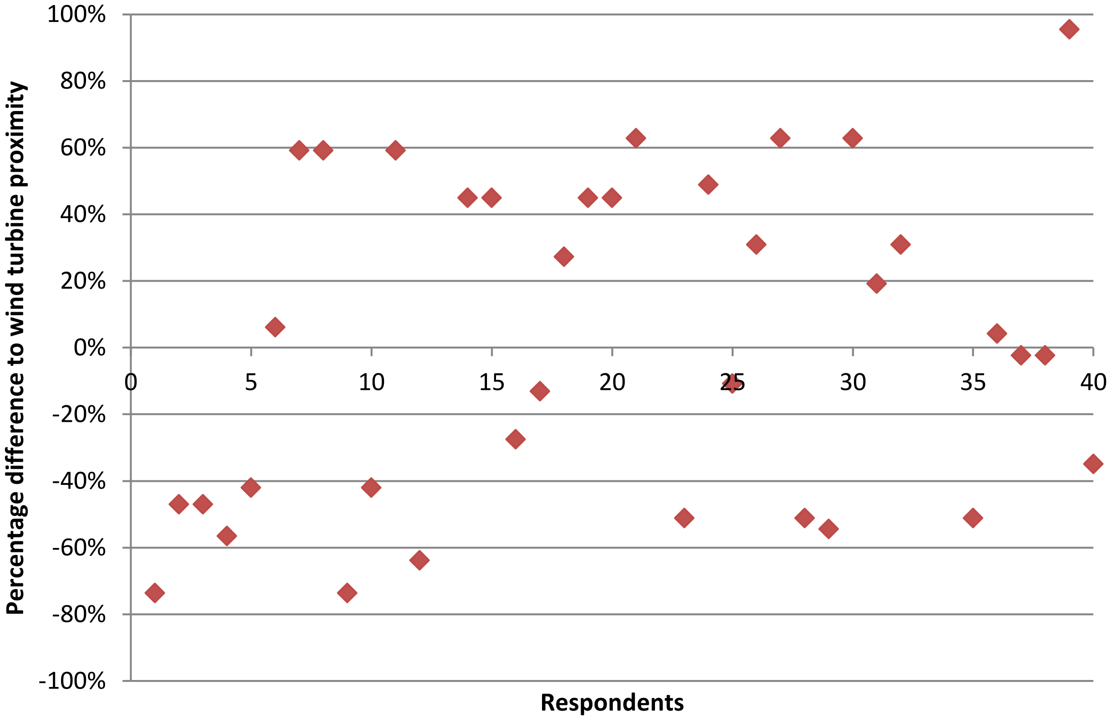



Figure 1.2: Graph showing difference between questionnaire respondents' estimations of wind turbine size compared to actual wind turbine size

[3] Study carried out at Whitelee Windfarm Visitor Centre with the permission of the Centre and Scottish Power Renewables, but conducted independent of these organisations.




*Note: responses > +/-100% omitted*

Figure 1.3: Graph showing difference between questionnaire respondents' estimations of wind turbine proximity compared to actual wind turbine proximity

It is not a problem *per se* if people cannot estimate size and distance, because it is the *scale effects* of a development that are more important than actual dimensions. Nonetheless, it is a problem if people are unable to judge the scale effects of a proposed windfarm from the provision of dimensions if this is the main way in which information on scale is provided to them, for example as part of a planning application.

To understand further the problem of people finding it difficult to predict and convey the scale effects of large structures proposed in a landscape, this research also included a review of written responses and representations for planning applications for windfarms (described in further detail in Appendix A.6). This found, not surprisingly, that the way in which scale was identified as an issue varied considerably between different responses and representations in relation to their purpose and by whom they were written. Nonetheless, there was typically little explanation of the predicted scale effects of a proposal, with many people just describing the dimensions of a scheme and leaving it up to the reader to make a judgement of scale effect from this information. This may be because people are more comfortable providing dimensions which are facts, rather than describing predicted scale effects which incorporate judgements that would be open to challenge, but it may also be that they just do not know how to communicate their concerns. This difficulty was raised by research carried out by Sustainable Energy Ireland (2003) which found that 35% of those that were opposed to windfarms could not articulate the reasons why.

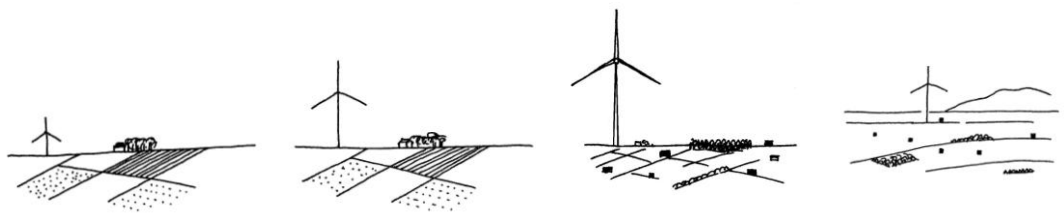
Of all the responses and representations reviewed for this research, it was expected that landscape and planning professionals would address scale issues in most detail, but it was found that few described the types of different scale effects and how these would be experienced. In addition, it was surprising to find that responses from Community Councils were typically fairly brief or relied upon very general statements such as a windfarm affecting 'scenic qualities'. This is despite the fact that a consultee such as this would be expected to have a very detailed understanding of the sensitivities of scale in their local landscape and how it was experienced and valued. Of all the responses and representations reviewed, it was Public Local Inquiry (PLI) Reporters that were found to communicate most clearly the nature and importance of scale issues. This could be because PLI offers the opportunity for a professional (the Reporter) to consider many different sources and types of information regarding scale included within technical reports, representations by local communities and individuals (verbal and written) as well as through site assessment. This is also somebody who has authority and, with this, may feel more confident about making judgements about the relevance and importance of scale effects perceived by different people within a landscape.

In addition to a reliance on conveying scale effects by quoting dimensions, there are two other reasons why people seem to find it difficult to predict the scale effects of large wind turbines proposed within a landscape: one, as the sizes of wind turbines have increased, they have become disparate in scale to other human features within the landscape that could otherwise be used as references for scale; and, two, it is difficult to demonstrate potential scale effect using the tools that are easily-available and understandable to most people. These issues are discussed in further detail within the following section.

#### 1.1.1.1 The disparity of wind turbine scale within the landscape

Contemporary[4] wind turbines in the UK were at first of similar size to other large human-made structures within the landscape, allowing a direct scale reference to these. Gradually, though, wind turbines got larger and larger in response to technical advances[5]. This meant it became increasingly difficult to make a direct scale reference between the new wind turbines and their surroundings.

As the size of wind turbines increased, most people expected the landscape and visual effects would increase proportionately and, to some extent, they did. Nonetheless, at a certain threshold, the relationship between the scale of wind turbines and their surroundings and people changed, as represented by Figure 1.4 below. This change in effects was revealed particularly clearly where old windfarm schemes were extended or 're-powered' using larger wind turbines to those used originally. As scale is a relative judgement, an increase of wind turbine size did not necessarily pose a problem with regards to the landscape and visual effects of a windfarm, as these could relate to larger and larger aspects of the surroundings, for example the overall profile of a distant hill range or the wide extent of sea instead of nearby buildings. Nonetheless, a consequence of this increasing disparity of scale to other structures in the landscape was that it became more difficult for people to make reference between the wind turbines and other human elements (Vroom, 2006) and thus to predict the scale effects of a proposal in relation to them, their community and their local landscape.



| Wind turbine reference to building | Wind turbine reference to wider farm | Wind turbine reference to wider local area | Wind turbine beyond scale threshold: no longer related to human elements of the landscape, although related in scale to hill backdrop |
|---|---|---|---|

Figure 1.4: Change in scale reference with greater wind turbine size

[4] For the purposes of this thesis, meaning from the 1980s onwards
[5] Usually for economic reasons, to capitalise on the logarithmic relationship between energy yield and the faster wind speeds that occur at higher elevations

The problem of increased disparity of scale between large wind turbines and other human elements within a landscape has generally been recognised insufficiently within planning policy and good practice guidance. Alternatively, many of these documents still assume that people will be able to make this human scale reference as they did in the past and, in doing so, inform a judgement of whether a structure is 'in scale' (discussed further within 2.8 of chapter 2).

#### 1.1.1.2 A difficulty of demonstrating potential scale effects

The Landscape Institute and Institute of Environmental Management and Assessment (IEMA) (2013) state that *'reporting on the assessment of the significance of the identified effects in LVIA[6] should aim to provide information in a manner that will help decision makers' (p46)*. Following this guidance, information should be provided for either a professional or a member of the public to be able to judge the landscape and visual effects of a proposed development and, as part of this, the potential scale effects of a scheme. Unfortunately, though, this information is often not provided for a proposed development. This is supported by a recent study by SLR and Hoare Lea Acoustics (2015) which found that only 38% of respondents to a survey regarding constructed windfarms said that the windfarm appeared 'as expected' or 'broadly similar' based on the information available during the planning process. For respondents of this study, the key differences identified were the turbines being more prominent and the size of the wind turbines appearing larger and closer (p30).

One of the main tools within an Environmental Impact Assessment (EIA) for illustrating the visual effects of a proposed development, including visual scale, is computer-generated visualisations (for example as shown in Figure 1.5). From the 1990s, there was widespread complaint that these visualisations were of poor quality, misleading and down-playing the 'true' scale effect of windfarms (for example: Architech Animation Studios, 2007; Caudery, 2009). These complaints were sometimes justified because of inexcusable poor execution, for example photographs taken in poor visibility conditions; nonetheless, this criticism often focussed instead on the technical methods of production, such as questioning the camera lens length and image field of view. To address this and establish agreed standards,

[6] Landscape and Visual Impact Assessment

Scottish Natural Heritage (SNH) and The Landscape Institute produced in 2006 and 2011 respectively guidelines that set out the technical requirements for accurate visualisations based on mathematical, geometrical and photographic principles.

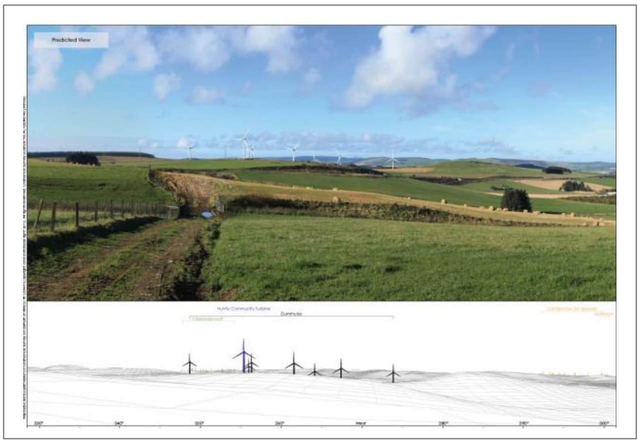


Figure 1.5: Example of a visualisation of a windfarm[7]: computer generated photomontage and corresponding wireline diagram.

Although the standard guidelines produced by SNH and The Landscape Institute clarified the requirements and scope of visualisations for landscape architecture, some people outside the profession still questioned and doubted the accuracy of the resulting products. For these, a key challenge seemed to be their expectations of what visualisations could and should deliver, with some professionals and members of the public still questioning the validity of visualisations because they did not convey to them the actual *experience* of effects in the landscape, nor provide 'the answer': ie, they required a great deal of interpretation and analysis to make a judgement of the significance of effects of a proposed development (SNH, 2011a). Some believed that these shortcomings must derive from the method of production, not appreciating the difference between what we experience in the landscape and what a two-dimensional image can represent even if following the best possible technical methods. This is despite the difference between photographs and our experience of a landscape being long-established[8] (discussed further in 2.3). For example, Rogers (1995, p121) states '*in direct contrast to pictures, the optic array not only surrounds the perceiver but is continuously transformed by the perceiver's activity within the environment*'. A number of suggestions for alternatives were made by critics (summarised

[7] Reproduced with the permission of Atmos Consulting
[8] And understood by most people when they look at their holiday photographs and protest that these do not represent how the subject was in reality

within Appendix A.7) but, not surprisingly, these did not address the specific problem of being able to demonstrate clearly the potential scale effects [9]of proposed windfarms.

As some people have continued to struggle to understand the scale effects of proposed windfarms, one approach to illustrate effects commonly adopted has been height comparison diagrams or descriptions (for example: Dinwoodie, 2010; East Lothian Council, 2010; Pasqualetti, Gipe and Righter, 2002; Rowney, 2009). These illustrate the size of wind turbines alongside familiar features, such as the London Eye or Big Ben, as shown below in Figure 1.6. Similarly, descriptions of proposals often make reference to other objects for which it is hoped the reader can make scale reference, for example a London bus, football pitch or even elephants (see Appendix A.3 for a list of objects described commonly for scale reference together with their dimensions). Whilst these diagrams are trying to be helpful and are based on an understanding that our perception of scale is relative, they are misleading because they do not acknowledge that our perception of scale effect also depends on the context in which an object is seen. This means our recall of the experience of a specific structure in one environment, such as Big Ben in London, cannot be transferred directly to the experience of a different structure of the same size in a different environment, such as a wind turbine on a rural hillside.

Figure 1.6: Scale comparison diagrams and descriptions. Top left is a scale comparison diagram showing the dimensions of a proposed wind turbine against the London Eye and Big Ben, with adjacent photographs showing the range of scale effects that can occur in reality.

[9] As well as other landscape and visual effects

Another method used to illustrate height on site has been the use of a blimp, which is a large balloon that is filled with gas so that it rises to the limits of a cord at a set height.  Whilst a blimp can be useful to confirm whether an object of a specific height would be visible or not from different locations, what it cannot convey is the perceived scale effect of a structure due to the lack of a clearly visible link and scale and distance cues between the blimp and the viewer and/or between the blimp and the ground.

Figure 1.7:  Example of a blimp being flown to indicate the height of a proposed wind turbine *(Photo: horner + maclennan landscape architects)*

An alternative way in which some authors and practitioners tried in the past to convey different scale effects was by categorising these (and other landscape and visual effects) in direct relation to various distance ranges, such as the Sinclair-Thomas Matrix (University of Newcastle, 2002b) and past guidelines by SNH (2009).   Nonetheless, these distance categories were not useful when applied in practice, principally because scale effects are not directly proportional to distance and are influenced by the landscape context and windfarm design.  For this reason, most matrices of this type have now been abandoned in Scotland, including by SNH in their most recent edition of 'Siting and designing windfarms in the landscape' in which they state these are '…*no longer considered helpful'* (2014a, p16).[10]

## 1.2 Why the problem of predicting and conveying scale effects needs to be addressed

The problem of predicting and conveying the potential scale effects of large structures poses difficulties for both the public and professionals.  Nonetheless, for professionals, a better understanding of scale effect is also required because of the following:

[10] Although some authors and practitioners still follow the approach of judging effects directly in relation to distance (for example Gillespies, 2014).  This seems to be, not because they are unaware of the limitations (and include caveats to describe these), but because the simplicity of these kinds of matrices are very tempting.

- They have a responsibility to be able to assess, describe and explain the predicted scale effects of a proposal in a manner that can be understood easily by others; and
- They need to be able to design structures to be of an appropriate scale in the landscape, to maximise positive effects and avoid or minimise negative effects.

### *1.2.1 The need to understand scale*

The starting point for people to be able to understand better the scale effects of large structures is a general knowledge of scale, which varies across the population. In his film 'A few tools for teaching scale', Eames Demetrios (2008) explains how people cannot really appreciate the nature of threats and opportunities within our environment without a general understanding of scale. He states that not understanding scale is a form of illiteracy and that:

> *'Just like knowing the map of the world gives you a place in your mind to hang new pieces of information about new places you hear about, similarly, having a sense of scale gives you tools for a new kind of understanding'.*

This requirement for knowledge to comprehend our surroundings is supported by Kaplan and Kaplan (1989) who describe the adverse reaction that people may have if they don't understand what they see or experience. Nonetheless, many people do not appreciate the requirement to learn about scale and, instead, assume this is automatic and understood equally by all.

A limitation for people's understanding of scale is that there is generally little combination or cross-over between perception theory and academic research with landscape assessment tools, good practice guidance or planning policy (Ward Thompson, 2013). This means that many studies do not benefit from being based upon knowledge and understanding of theory as well as assessment methods, design and planning.

The need to address now[11] the problem of understanding scale effect is amplified by two key aspects which are discussed within the following section: continued increase in the sizes of wind turbines and a need to inform the application of planning policy.

[11] In 2009-2016

### *1.2.2 Continued increase in wind turbine size*

The need to understand better the nature of scale effects has been amplified over time as wind turbines in the UK have increased in size, as described previously. This has not only resulted in greater scale effects, but has meant that much of the research and guidance addressing scale issues produced in the past has limited value. This is an important point to highlight because many publications produced in recent years have relied upon and/or refer to the findings of dated material without adequate recognition that this will have been based upon wind turbines which were much smaller than currently being proposed and built.

The trend for larger wind turbines is expected to continue[12], although it is not known what will be the eventual maximum size given this is currently influenced by many technical and practical factors, for example being able to transport wind turbine blades[13] to site, and aviation radar restrictions. The University of Dundee stated in 2013 that there was an expectation that onshore wind turbines may increase up to 200m to blade tip[14] but, as there are already wind turbines larger than this elsewhere in Europe (such as the 210m high wind turbine in Lausitzring), this prediction seems conservative.

### *1.2.3 A need to inform the application of planning policy*

Nadaï and van der Horst (2010, p143) state that: '*There can be very little doubt that energy will remain the number one driver for landscape transformation in the 21st Century*'. In Scotland, this change will be driven in part by the Scottish Government who has stated (2014a) that they aim for Scotland to produce the equivalent of 100% of the country's electricity demand from renewable sources by 2020. To guide this development, Scottish Planning Policy (SPP) (2014a) sets out general criteria for the acceptability of wind energy schemes, including reference to the scale of developments, whilst also acknowledging that: '*Planning permission should be refused where the nature or scale of proposed development would have an unacceptable impact on the natural environment'* (p47). To meet their aims, Scottish Government (2014b, p2) requires Planning Authorities to produce detail criteria for

[12] For example as highlighted by Pasqualetti, Gipe and Righter, 2002; Ladenburg and Dahlgaad, 2012; Jones *et al*, 2014; The Scottish Government, 2014a.
[13] Currently manufactured as a single piece
[14] The largest wind turbine in Scotland is currently at Methil, Fife, although this is a model whose design was aimed at use offshore. It is 196m to tip, 110m to nacelle and has 83.5 m blade length.

assessment of the capacity and suitability of wind energy schemes, including the influence of the number and height of wind turbines and the scale and character of the landscape.

Thresholds for landscape and visual effects are very important when designing or judging the acceptability of a proposed windfarm in relation to criteria set by the Scottish Government and local planning authorities. With regards to scale, these thresholds are often described as a scheme needing to 'reflect' or 'be in scale' with its surroundings, but a key problem is that there is typically no definition of what this means in terms of the numbers or sizes of wind turbines in different locations. This means that developers, the public, consultees and decision-makers have to make the big jump themselves between analysing the information available within an EIA[15] and judging the acceptability of a scheme.

It is acknowledged that scale effects are just one aspect of landscape and visual effects assessed by a LVIA and an EIA. Nonetheless, significant adverse scale effects may result in a proposed scheme being unacceptable: ie acting as the 'deal breaker'. This is because, if the scale of a development is inappropriate, no end of other design measures can usually make it acceptable.

## 1.3 Terminology

An important issue to highlight in this introductory chapter is the terminology used throughout this thesis and descriptions are provided below of key terms. Additional terms are described within a glossary in Appendix A.1 in addition to a list of Acronyms (although it is hoped that most readers familiar with the subject of this thesis and/ or landscape architecture should only need to consult these for occasional reference).

| | |
|---|---|
| *Scale* | It is important to highlight that scale is different to size. Scale is a word that can be used in a multitude of different ways but, in the context of this research, it is used to mean relative size or extent. It is a quality that exists in relation to something else. |

[15] Including LVIA

*Scale effect* Although this research explores perception of scale in the landscape, its main focus is *scale effects* in the landscape. Within the context of this research, the definition of effects is taken from the Guidelines for Landscape and Visual Impact Assessment[16] and a scale effect is defined as a change arising from the scale of a development.

*Effect/impact* The words effect and impact are used interchangeably by some authors but, following GLVIA3, this thesis uses 'effect' to describe change resulting from an impact and uses 'impact' to describe the action being taken that results in a change.

*Overbearing scale effect* Within this thesis, overbearing scale effect is a term used to describe a high level of scale effect (the identification of this term is described in chapter 7). In this context, overbearing scale effect occurs where an element appears larger in scale to other elements within the surrounding landscape and/or those judged as normal. An overbearing scale effect may be judged visually or spatially and upon the experience of a landscape and its qualities and value as perceived by people.

*Sensitivity* This is a term, following GLVIA3, applied to specific landscape or visual receptors, combining judgements of the susceptibility of the receptor to the specific type of change or development proposed and the value related to that receptor.

The specific meanings of terms have been important for this research. This is partly because scale is often described ambiguously, but also because, although terms may be applied fairly consistently by landscape architects within the UK, many of the publications that have informed this research have been written by other professionals that use the same terms in different ways. Terms that tend to be used differently by other professionals include the distinction between: effects and impacts; landscape effects and visual effects; visibility or prominence and visual effects; perceived natural beauty, landscape value or attractiveness and the sensitivity of the landscape or visual resource; and measures of magnitude or significance of effect. Great care has thus had to be taken when reviewing and cross-comparing published literature for this research.

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[16] Landscape Institute and IEMA, 2013, pp8-9


Figure 1.8: Cartoon by Tim Harries (2015)[17]

[17] Reproduced with the permission of Tim Harries

# Chapter 2

## THEORETICAL BACKGROUND

To begin to address the problem statement, this chapter reviews existing theories and literature on which the research can build. This ascertains the existing research base and where limits and gaps occur, leading to identification of research questions and hypotheses towards the end of the chapter.

The theoretical background described by this chapter is divided into a number of discrete subjects, as shown in Figure 2.1 below.

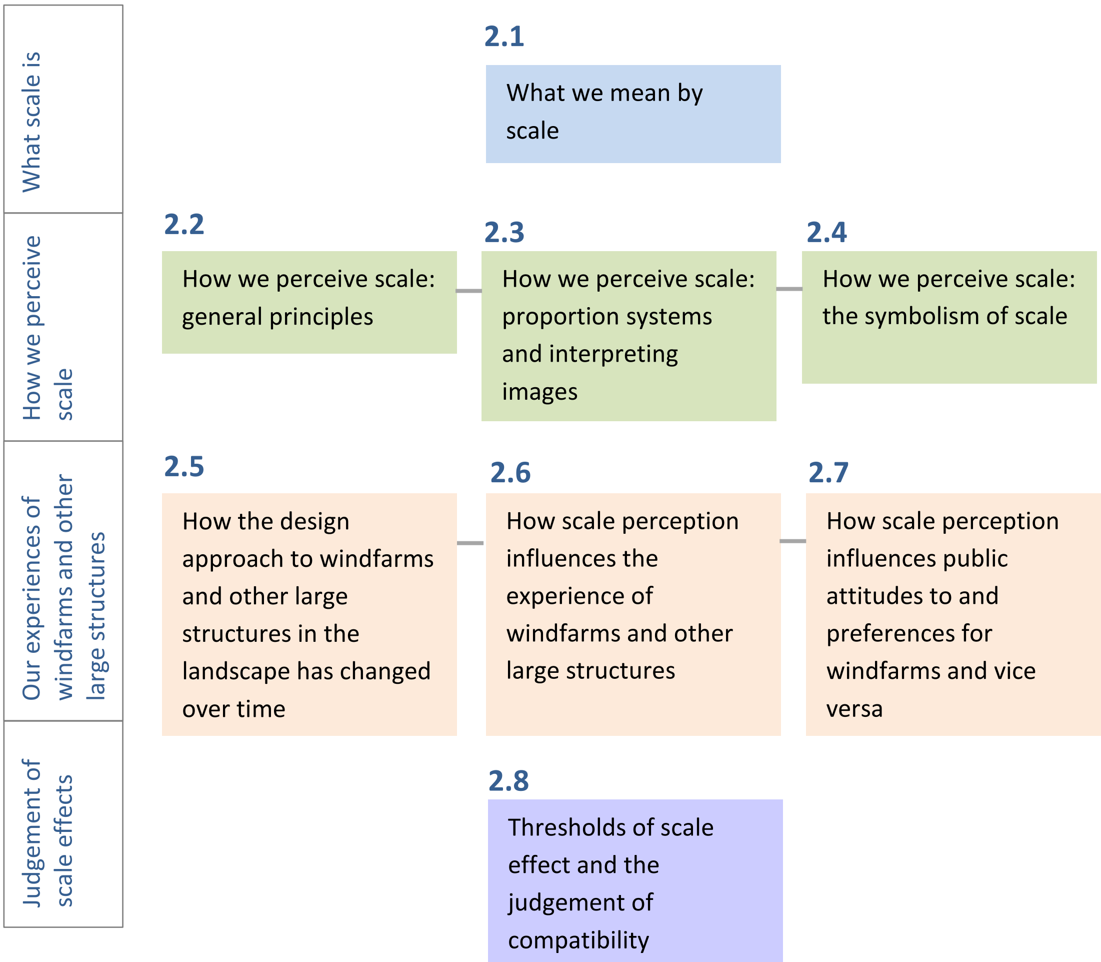


Figure 2.1: Outline of theoretical background in chapter 2

In addition to the subjects shown in Figure 2.1, the theoretical background for the methods is described in chapters 3 and 4. Brief descriptions are also included in chapter 3 for subjects that provide important context, but are not the focus of this research and are thus not examined in detail.

There is little existing literature specifically regarding the perception of scale effects in the landscape. Instead, what exists tends to be general in nature and falls within two main categories: academic literature and more practical guidance or policy documents, as summarised below in Table 2.1.

Table 2.1: Main types of literature that informed the research

| *Main subjects of research literature* | *Main subjects of guidance/ policy documents* |
|---|---|
| • The perception and experience of the landscape, including scale<br>• Architectural scale and massing, including structures and spaces (relationship of buildings to each other and to people)<br>• Vision, visual perception and visual design principles<br>• Visibility, including meteorological<br>• The scope of visualisations<br>• Public attitudes to windfarms, particularly in Scotland and the UK[18]<br>• Environmental psychology, preferences and how people make judgements<br>• Community, arts and/or social/cultural projects concerning windfarms | • General landscape architectural publications<br>• Government or Local Planning Authority planning policy and advice<br>• Guidance for assessment methods<br>• General guidance on the landscape and visual effects of large scale structures, including hydro-electric schemes, masts and power-lines<br>• Guidance on windfarm design and the landscape and visual effects of windfarms[18]<br>• Landscape capacity studies (identifying scale thresholds)[18] |

A list of the individual publications that are referenced in this thesis are included at the end of the thesis, whilst a bibliography is also included within Appendix A.4 that lists publications that informed the research, but are not referenced directly.

Whilst the range of published literature on which this research builds covers a wide range of professional disciplines, it is highlighted that this research is located within the discipline of landscape architecture[19].

[18] These are typically dated and describing the effects of windfarms smaller than now proposed.
[19] This research is being carried out within Edinburgh School of Architecture and Landscape Architecture (ESALA) and the researcher is a Landscape Architect and Chartered Member of the Landscape Institute (CMLI)

## 2.1 What we mean by scale

We use the word 'scale' in many different ways. The Oxford English Dictionary (2012) provides six alternative definitions (as reproduced in Appendix B.1) and, from these, this research concerns scale as 'relative size or extent'. Nonetheless, there are also particular ways in which this term is applied in landscape architecture and related disciplines. These are described within the following section, including some types of scale and scale perception that are not typically highlighted within publications.

Moore and Allen (1976, p17) state what may be thought as obvious: that everything has a size and a scale[20]. Nonetheless, it is stressed by a number of authors[21] that we have to learn how to perceive scale despite a common assumption that this is automatic or spontaneously instinctive.

The primary sense through which we perceive the scale of structures is sight, although it is important to highlight that the qualities of scale in a landscape are not just visual, but also spatial, as shown in Figure 2.2 below.

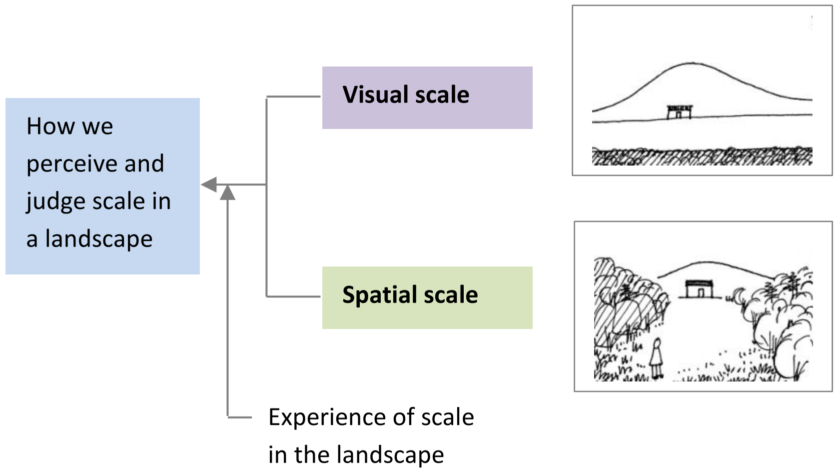


Figure 2.2: The distinction between visual and spatial scale that influence how we perceive and judge scale

*Visual scale* represents the scale of an element seen within a view, for example the visible height of a wind turbine in relation to a hill. Conversely, *spatial scale* refers to the spatial

[20] Although Demetrius highlights in his film 'A few tools for teaching scale' (2008) that exclusions exist such as beliefs, dreams and feelings.
[21] For example de Sausmarez (1964), Demetrius (2008), Kaplan and Kaplan (1989).

characteristics of a landscape that typically respond to the extent of a space in relation to the height and form of its edges and elements located within and around it. This influences the sense of enclosure (Dee, 2001).

As scale is relative, a judgement of scale requires a reference to be made. This occurs in three different ways, as shown in Figure 2.3 below.

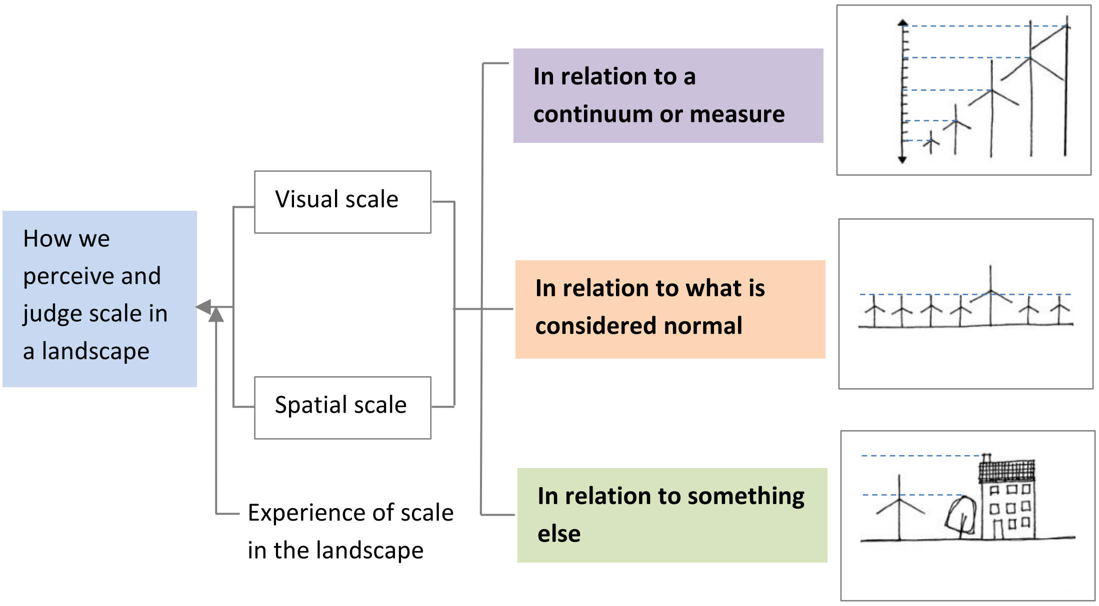


Figure 2.3: Different types of scale reference leading to how we perceive and judge scale

Our perception and judgement of scale usually depends on more than one of the scale references shown in Figure 2.3 above and these may also have varying degrees of influence. This is important to highlight because people often mention just one type of reference (if any) when describing scale, without acknowledging that their perception is also influenced by other references.

### *2.1.1 Scale in relation to a continuum*

Scale occurs along a continuum and 'large' or 'small' are always connected, occurring between the opposite ends of a spectrum[22]. An observer can flip their focus between different points along the continuum of scale, for example from concentrating on the details of a flower to the pattern of stars in the sky. Nonetheless, Mallinson (2012, p109)

[22] Illustrated excellently by the film 'Powers of Ten' produced by Charles and Ray Eames (1977).

highlights that this elasticity of scale can also mean that it can be hard to 'take our bearings': to know how things fit within the overall range of scale and to make suitable scale references.

It is important to realise that the continuum of scale is not just linear or sequential. Indeed, the study of scale in geography has identified a number of potential models for considering scale: not only as a ladder (considering above/below) and in concentric circles (considering larger/smaller) that are depicted commonly, but also using metaphors such as Russian dolls (contained/ containing) and tree roots or spiders' webs (networks) which contrast in linearity, hierarchy and centralisation. Herod (2011) highlights that the value of considering scale[23] is not in delineation itself, but how this changes the importance and relevance of different variables. Similarly, Moore and Allen (1976, p4) pose the question: '*what are the variables to be observed*' and '*what do you care to measure*?'

The most common way in which we describe scale in relation to a continuum is using standard units of measure. Tavernor (2007), like others before him such as Le Corbusier (1954), raises the importance of assessing and designing in units of scale that people can understand. He states (p10): *'By using numbers and symbols as the principal language to relate abstract and concrete ideas ...difference in qualities have been turned into abstract scientific quantities... incomprehensible to and remote from everyday human experience'.* Tavernor believes that the use of metric units (such as the metre) as a standard unit in construction, unlike the inch, foot or bricks[24], means that modern architecture has become detached from human association. He suggests that, whilst one of the aims of metrification was the establishment of universal measures, this does not recognise that measures represent more than just quantity and have practical and symbolic values[25].

[23] Which he organises into 'the body', 'the urban', 'the regional', 'the national' and 'the global'
[24] In the same order: the size of a thumb from the first knuckle to tip; a foot; or a block that can be held easily by the human hand.
[25] Tavernor (2007) uses as an example the 'Smoot', which was established in 1958 by a class of the Massachusetts Institute of Technology, when they used the body of a freshman called Oliver Smoot (height: five feet seven inches) to measure Harvard Bridge to be 364.4 Smoots +/- an ear.

Figure 2.4: Scale reference for two structures of the same height: the Tate Modern tower (old Southbank Power Station) for which there is the human scale reference of individual bricks in contrast to the simple, uniform shape, texture and colour of wind turbines at Redbog, Aberdeenshire.

### 2.1.2 Scale in relation to what is considered normal

A judgement of scale in relation to normality[26] is often ambiguous because what we consider normal can change over time and vary according to cultural or social differences (for example as per Box 2.1 below). In the film 'A few tools for teaching scale' (2008), Demetrios highlights that different people may also have different starting points for observing and judging scale, for example chemists looking at things at $10^{-8}$, runners at $10^{0}$, urban planners at $10^{3}$ and astronauts at $10^{7}$.

*Box 2.1*

An example of the ambiguity of describing scale in relation to what we consider normal is raised frequently in coffee shops in the UK when customers have to decide what size of drink they want based on names for relative sizes that vary between different establishments.

Looking at this image alone, is the cup a 'large', 'medium' or 'small'?

The relative scale of the cup can be understood on seeing the full range

Figure 2.5: The relative scale of coffee cups

[26] Ching (1996, p278) refers to scale that involves comparison to a normal as 'visual scale' and contrasts this to scale in relation to an accepted standard or measure which he terms 'mechanical scale', but these terms do not seem to be used by other authors and have thus not been adopted by this thesis.

### *2.1.3 Scale in relation to something else*

The scale of different elements of a landscape can be conveyed by making references between them. To limit ambiguity, it is preferable if scale references are of a known size, such as a house or car, although even these can vary in their dimensions. A common scale reference often used is us, a person, leading to the term 'human scale'. Tavernor (2007, p7) describes how valuable the person is as a scale reference, highlighting '*nothing is more readily accessible in everyday experience than the human body and its constituent parts…*' Nonetheless, Dee (2001) highlights that 'human scale' is also a relative term, especially with regards to the differences between adults and children.

When making scale references, these are often described as proportions. Ching (1996, p278) distinguishes scale and proportions by describing scale as being judged in relation to something else, whilst proportions refer to the relationship of one part to another or to the whole. Mallinson (2012) highlights the importance of proportions in the past, when fractions were used as an ordering mechanism prior to decimalisation, whilst Coyne (2012) and Padovan (1999) underline the link between scale proportions in architecture and ratios in music. Further description of proportions with regards to mathematical systems is included in section 2.3.

## 2.2 How we perceive scale: general principles

The term perception is used to describe our experience of something as detected through our senses (Motloch, 2001). Rogers (1995, p121) highlights that, as such, '*perception is constructed by the perceiver'* so that, whilst stimuli may be physical, for example a space or object, perception is a mental construct.

The general principles of perception apply to scale as they do to other qualities of our environment, and these are described within a range of existing literature, for example Bruce, Green and Georgeson (1996) and Ward Thompson (2013). These explain that there are various theories for how and why we perceive our surroundings, with key differences being between direct or indirect perception and constructivist or ecological theories led by proponents such as Marr and Gibson. These reflect alternative opinions on whether our perception is influenced most strongly by what is around us in the environment or, alternatively, by our own mental constructs and interpretation. Nonetheless, many models include aspects of both these stimuli and thus the key differences lie in the relative influence or priority of these.

While vision and visual perception has been the subject of extensive study dating as far back as ancient Greece, the modern study of visual perception in psychology has its roots in sixteenth and seventeenth century epistemology, particularly the work of Descartes. This position in history at which theories of perception developed is very important because, while many of the physiological principles remain sound, their age means they lack a post-Darwinian perspective (Heft, 2010). Consequently, they tend to focus on a comparison between vision and image capture by a camera, often without adequate consideration that perception is linked to *why* we need to perceive and is influenced by context and experience (Aspinall 2010b; Bell, 1999; Berger, 1972; Gregory, 1998; Heft, 2010; Ward Thompson, 2013). Gregory (p2) states that: '*the eye is a simple optical instrument'*, but it is the brain that adds understanding. He adds that '…*what we see, and what we know, or believe, can be very different*'.

As perception involves interpretation by our brain, it is also influenced by our knowledge and cultural or social factors. Gregory describes how this knowledge is applied through perception because it has survival value, for example the ability to catch an object flying through the air whose route we cannot possibly follow with our eyes due to its speed. Furthermore, Ching (1996) describes how prior-knowledge influences our judgements of scale and form in relation to materials, for example perceiving that a slab is thick enough to form a bridge over a gap based on our prediction of its strength.

There can be a big difference between what we theoretically 'see' with our eyes and what we notice (All in the Mind, 2014; Chabris and Simons, 2010; University of Newcastle, 2002b). This is because, during the process of perception, our brain is selective in the information that it sources and registers, effectively as a shortcut to help us save energy and time, as well as providing focus on what is judged as most important.

A number of demonstrations of this difference have been made in the past, such as the Ames room developed in 1934 by psychologist Adelbert Ames II, which reveal how our brain may take visual information and make an incorrect judgement. In this example, we assume the room must be rectangular and thus the people are of strongly contrasting size, as shown in Figure 2.6.

Figure 2.6: Demonstration in an Ames room of the perception of a regular space and strongly contrasting sizes of people

A more recent demonstration that has attracted attention online[27] and is described in the book 'The invisible gorilla' (Chabris and Simons, 2010) involves an experiment where participants were asked to count the number of passes of a basketball between members of one team (whilst ignoring the other team). By concentrating hard on this specific task, about half of the participants did not notice a person dressed in a gorilla costume passing across the middle of the scene. This effect is termed 'unintentional blindness'. There have been a number of other experiments to explore this phenomenon, including those that have used eye trackers to confirm that the people who do not notice the gorilla[28] look in its direction for about the same duration as those that do notice the gorilla, proving that noticing an object does not necessarily follow vision of an object.

With regards to scale perception, the findings of these explorations are important for highlighting that the perceived effects of an object in a landscape will not necessarily relate directly to the characteristics of the object that can potentially be 'seen' or its visual prominence. This is supported by the University of Newcastle (2002b, p17) who state that, although size and distance of a windfarm are basic physical measures that affect theoretical visibility, the key issue influencing its effects is perception.

### 2.2.1 Processes and cues for perceiving scale

Our perception of scale is influenced by a number of different processes and cues. There are a number of publications that explore and describe these in detail, for example: Arnheim, 1974; Bruce, Green and Georgeson, 1996; Gregory, 1998; Heeger (2006) and

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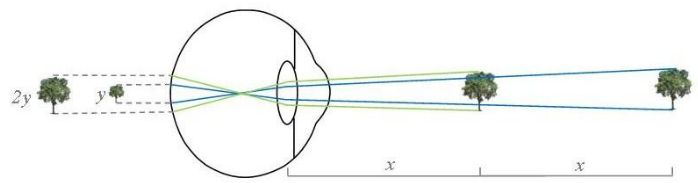
[27] The film can be watched at http://www.theinvisiblegorilla.com/gorilla_experiment.html
[28] Or equivalent unexpected object

Hoffman, 1998. With regards to the perception of scale in the landscape, Table 2.2 below summarises the processes and cues that are most important.

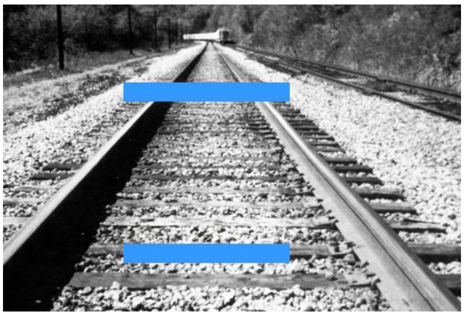
<table>
<tr><th colspan="2">Table 2.2: Key processes and cues relevant to perception of scale and scale effects in the landscape</th></tr>
<tr><td colspan="2">Binocular Stereopsis<br>Animals with two eyes and overlapping visual fields have binocular stereoscopic information available to them, as each eye can look at the same scene from different positions, forming slightly different images, which are then combined in the brain to indicate distance. Stereopsis is most effective at short distances due to the greater disparity between the images from each eye (Bell, 1999). At further distances, the difference between the two images becomes smaller, effectively meaning that our image of a very distant object is similar to having been viewed with one eye (Gregory, 1998).</td></tr>
<tr><td colspan="2">Pictorial cues to depth<br>Pictorial cues to depth (so called because they have been long-used by artists) give depth information. Many of these cues are varieties of perspective, arising from the way in which a three dimensional world is projected onto a two-dimensional retina from a particular viewpoint.</td></tr>
<tr><td>Atmospheric scattering</td><td>With increasing distance, the contrast, clarity and brightness of objects are diminished and thus also their visibility. There are also different spectral properties, as light is scattered and absorbed in the atmosphere, with more distant objects appearing bluer.</td></tr>
<tr><td>Occlusion</td><td>An object that is situated beyond another is screened or partially screened by the closer object. Bruce, Green and Georgeson (1996) describe how Gibson claims reversible occlusion underlies our confidence in the view of our surroundings representing the wider environment, with even those surfaces hidden momentarily still being perceived.</td></tr>
<tr><td>Linear perspective</td><td>Linear perspective is a well-known pictorial cue to depth based on simple geometry, responsible for the retinal image of an object being proportional to an object's size, but inversely proportional to the distance of the object (meaning something twice the distance appears half the size)[29]. As our eyes are elevated above the ground, there are also differences in the height in the visual field of images cast by objects at different distances, with further objects imaged higher in the visual field.<br><br><br>Figure 2.7: The relationship between retinal projection and size and distance</td></tr>
<tr><td>Textural perspective</td><td>An indication of distance is provided by the amount of textural detail evident, as this diminishes with increased distance (Hawkins and Marsh, 2001).</td></tr>
</table>

[29] One of the most popular scenes in comedy (raised often by attendees of presentations for this research) that highlights the importance of linear perspective and the need to learn perception comes from the UK Channel 4 television series 'Father Ted', in the scene named 'small, far away' (*Father Ted: Small, far away,* 2012). In this scene, Father Ted tries to explain to his simple-minded assistant, Dougal, the difference between small cows (holding some small toy models) and the cows that Dougal can view in the far distance, but to no avail!

Table 2.2: Key processes and cues relevant to perception of scale and scale effects in the landscape

**Scale constancy**
This is the phenomenon by which our brain adds knowledge about the scale properties of objects, acting against our perception of scale through linear perspective. Bruce, Green and Georgeson (1996) explain how the consequences of this are paradoxical, as relative size acts as a cue to distance, but then distance is assessed to judge the apparent size of the object.

There are many exercises that can be followed to illustrate this phenomenon, including that of standing two metres from somebody and telling them your height and then moving back a further two metres and questioning whether they look half the dimension[30]. This effect is also illustrated clearly by Figure 2.8 below.



The two blue oblongs are the same size, but we judge the top one to be larger because we perceive it to be further away and thus assume it must be larger to appear the same size

The man is exactly the same size in both images (1.4mm), but we judge the man in the right hand image to be smaller because we perceive him to be closer and thus assume he must be smaller in reality to appear the same size in the image

Figure 2.8: Examples of how scale constancy affects our perception of scale (*Images from Heeger, 2006, reproduced with the permission of Professor Brian Wandell, Stanford University*)

**Clarity of object and 'figure and ground'**
Following the cue of atmospheric scattering, objects that appear clearer in views than their background are perceived as being closer to the viewer. This effect can be amplified by a simplicity of shape or when an object is of strongly contrasting colour, form or solidity, known as 'figure and ground' (Bell, 2004; Ching, 1996). For wind turbines in Scotland, this effect has been found to be particularly pronounced where white or light grey wind turbines are seen backclothed by dark, steep, heather-clad hills (Stanton, 2012b; University of Newcastle, 2002b).

**Object recognition**
This is the ability to perceive an object's characteristics, such as its shape or scale, even if these are not absolutely clear from a particular viewpoint, based upon recognising common characteristics and informed by previous experience. To achieve object constancy, there is a need to extract some kind of commonality across different viewpoints in varying conditions, for example lighting and orientation. Different theories exist for object recognition (Bruce, Green and Georgeson, 1996; Gregory, 1998) based on, for example, the role of viewpoints, memory, and recognition of components or structures. Our ability for object recognition is tested where visual ambiguity occurs, for example as is demonstrated by images that can appear to illustrate two different things, such as Rubin's Vase (2015) that seems to show either the profile of a vase

[30] The researcher has found this to be the demonstration that is most clear to different audiences when presenting this research.

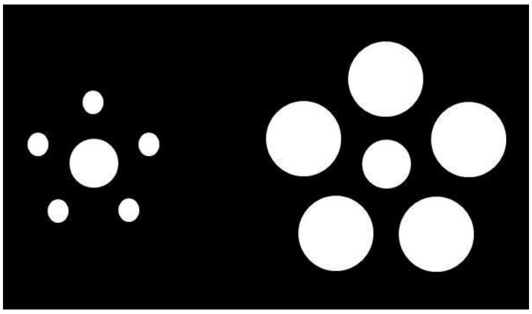
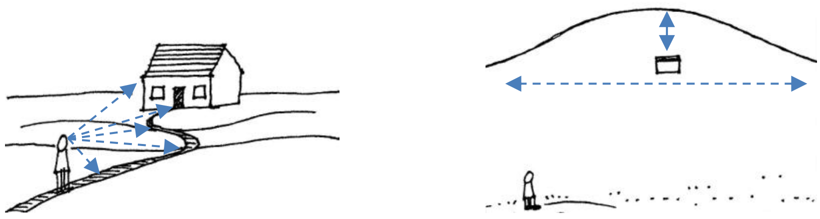
| Table 2.2: Key processes and cues relevant to perception of scale and scale effects in the landscape |
|---|
| or two people facing one another. |
| **Depth from motion**<br>When an observer moves through a stationary environment, motion parallax results in closer objects appearing to move past us faster than distant objects. In reverse, if an observer is stationary, but an object is in motion, the speed at which is seems to pass also indicates its proximity. |
| **Monocular physiological cues**<br>When we fix our view on an object, we typically adjust our vision with the power of our lens to focus upon this, and this effort provides a cue to depth. After we have focused upon the object, the fact that other elements further or closer are blurred indicates their relative distance (Heeger, 2006). |
| **Scale reference**<br>Scale reference involves comparing one thing with another (represented in Figure 2.3). When making scale references, it is important to appreciate that our perception of the scale of one element may be influenced by size contrast, judged in relation to the surrounding context. This is illustrated by Figure 2.9 below, in which the centre circles for both clusters are of exactly the same size but they appear different in relation to their surroundings.<br><br>Figure 2.9: Size contrast: the scale of each central circle is judged relative to its surroundings, so the two central circles appear of different scale even though they have identical dimensions<br>It is often easiest to quantify a scale relationship using proportions, for example judging something as half or twice the scale as something else, particularly when the references are of the same form or shape. Conversely, where a scale relationship is difficult to quantify, people tend to use less precise descriptions, for example something just being larger or smaller (Moore and Allen, 1976).<br><br>Scale reference is easiest where the elements to be compared (including oneself as a human) are of similar size and/or close together. Where, conversely, elements are disparate in scale and/or faraway, it tends to be easiest to make an abstract visual scale comparison (Arnheim, 1974; Moore and Allen, 1976) as shown in Figure 2.10 overleaf. |

Table 2.2: Key processes and cues relevant to perception of scale and scale effects in the landscape

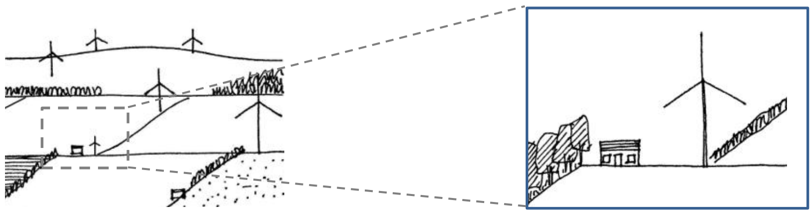


Easy scale reference between viewer and object as close in proximity and scale

Difficult scale reference as object distant and disparate in scale to viewer. Thus viewer makes judgement in reference to another element (the hill backcloth in this example)

Figure 2.10: Ease of making scale reference with elements of varying scale and distance

As scale reference is easiest between elements of comparable scale, we typically adjust our field of view accordingly when seeking references. This is an important process to highlight with regards to scale perception of an object in a landscape because it means we effectively ‘zoom’ in or out to select relevant scale references and, in doing so, judge the scale of one thing relative to a larger or smaller context.



Wider context observed to select scale references for large windfarm

Narrower context observed to select scale references for small wind turbine

Figure 2.11: Variation in context of view observed to make scale references

In certain places, there may be an absence of scale references, for example simple moorland or open water. In these situations, Vroom (2006) suggests that a landscape can appear ‘scale-less’. A lack of distance cues may also occur where the main line of a view is through the sky.

The need for visible cues to indicate distance is often highlighted by misleading photographs that seem to show a very small feature that is, instead, very distant (as per Figure 2.12[31]). Hawkins and Marsh (2001) highlight this effect is most successful within photographs because we can usually pick up distance cues more easily on site[32].

Figure 2.12: The impression of something being small because there is a lack of clear distance cues to indicate that it is, instead, distant[31]

The importance of scale reference is recognised by meteorologists who need to make judgements of the heights of clouds as well as the quality of visibility based on the distance that can be seen. To do this, field

[31] Photograph by Owen Saward

[32] This also highlights a key skill of drawing and painting to emphasise elements at different distances to convey depth in a view

| Table 2.2: Key processes and cues relevant to perception of scale and scale effects in the landscape |
|---|
| meteorologists are advised to establish the height and distance of a number of landmarks surrounding observation points (Met Office, 1982).<br><br>Architects too have sometimes used the process of scale reference to their benefit, as it has allowed them to manipulate perceptions through design, for example 'oversizing' some elements such as doors to alter people's perception of the scale of buildings and adjacent spaces. |

#### 2.2.1.1 The reality of perceiving scale

Whilst people are often familiar with the types of illustration shown in Figures 2.8, 2.9 and 2.12, their common description as 'illusions' may suggest that there is some kind of magic or pretence involved. Conversely, there is infrequent recognition that they represent the reality of how we perceive, albeit a mental construct[33]. This may be influenced by the process of perception being unavailable to us consciously and also the effects of perception being variable, which can have some surprising effects when certain cues seem rejected or 'overruled' by the brain (for example, as demonstrated by the man in the right hand image of Figure 2.8 still seeming smaller after measurement has proved that he is the same size in both the left and right hand images).

## 2.3 How we perceive scale: proportion systems and interpreting images

Theories on scale and proportions in aesthetics are thought to date back as far as ancient Egypt (Tavernor, 2007), although it was Vitruvius[34] that developed this thinking further to establish theories based upon perfect numbers and the Pythagorean concept that numerical relationships contribute to harmony in the universe.

A number of different theories for proportional relationships exist such as classical orders, the Ken[35] and the Golden Section. The latter is influenced by Fibonacci numbers[36], which are those that equate to the sum of the two preceding numbers, ie: 0, 1, 2, 3, 5, 8, 13, 21, 34

[33] Perhaps because, conversely, the simpler principles of geometry are easier to understand
[34] Marcus Pollio Vitruvius, a Roman architect (*circa* 85 BC - *circa* 20 BC)
[35] This is a traditional Japanese unit of measure which is absolute and used in constructing buildings as well as being applied as an aesthetic module for ordering the structure, materials and spaces of Japanese architecture.
[36] Named after Italian mathematician, Leonardo of Pisa (circa 1170-1250), who was better known as Fibonacci.

and so on.  These have been called the 'perfect' ratio[37] or the 'divine proportion'[38], but subsequently became known as the Golden Section, incorporating *phi* which has a ratio of 1:1.618 or 10:16.  This was believed by Greeks to be the perfect proportional relationship (Motloch, 2001) and a well-known example cited for its application is the Parthenon in Athens[39].  The Golden Section ratio was also used extensively during the Renaissance and was the starting point of Le Corbusier's 'Modular' (1954).  Ching highlights that, although proportional relationships '…*may not be immediately perceived by the casual observer, the visual order they create can be sensed, accepted, or even recognized through a series of repeated experiences'* (p284).

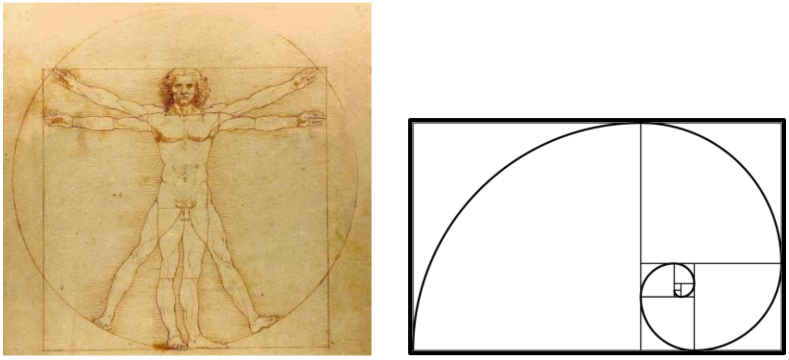


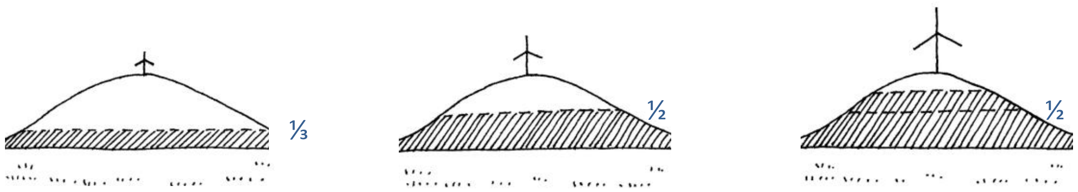
Figure 2.13:  The Vitruvian Man, Leonardo da Vinci (c1490), and a Fibonacci spiral which approximates the Golden Section (2016)

Despite the appeal of proportional systems to provide a frame of reference, Padovan (1999, p3) warns that people may confuse what is 'good' and what is 'graspable by human reason'. He outlines an alternative to the theory of 'empathy' described by Ching, which is the theory of 'abstraction': that we are not responding to mathematical systems but, alternatively, we are imposing mathematical systems to make elements seem more understandable to us.  A major proponent of abstraction was Dom Hans van der Laan (Padovan, 1999; Voet, 2016) who highlighted that, because scale occurs along a continuum, there is infinite scope for division in various proportions.  Consequently, the key challenge is not to refer to scale by comparing one element with another, but to identify where thresholds occur for different scales: ie, the distinction between perceived scale similarity and difference.  Van der Laan believed there are limits within which sizes can relate to each other and, beyond this, where scale relationships break down.  He identified a measure of

[37] Referenced by Tavernor as coming from Johannes Kepler, astronomer
[38] Referenced by Tavernor as coming from Luca Pacioli
[39] Although Padovan questions whether it was applied for the Parthenon

3:4 (1:1.325) for this relationship which he called 'the plastic number'.  This is not a fixed measure or ratio to be imposed upon objects as designers have with other proportion systems but, instead, is a way of looking and understanding which scales the brain recognises as belonging to the same type.  It explains why, along an infinite continuum, we may disregard small differences of scale, yet recognise collective groups of others.

A derivation of the Golden Section applied commonly in art, architecture and landscape architecture is the 'rule of two thirds' (Bell, 2004; SNH, 2014; and SNH and The Countryside Agency, 2002b).  Bell describes this as reflecting a pragmatic approximation of the Golden Section proportions.  He explains that a division of proportions of one-third to two-thirds '*generally seems to look better'* than either two equal proportions or where a feature is over one-half the proportion of another and seems to '*over-dominate and even become oppressive'* (p139-140).  This is illustrated in Figure 2.14 below.




Up to one third height　　About one half height　　More than one half height

Figure 2.14: The scale effects of different proportional relationships with a hill feature

Although proportion systems established in the past remain useful for reference, it is important to consider their suitability in contemporary situations.   Tavernor (2004) warns that the historic writings of Vitruvius, Alberti and Sitte do not address the issues of modern tall structures as they were only concerned with human scaled environments of their day.

### *2.3.1 Interpreting images to judge scale*

A key issue regarding the perception of scale and scale effects is the difference between what we perceive and experience in a landscape and what we perceive and experience when looking at an image.  Ward-Thompson (2013) highlights that, if you accept landscape perception is derived from a dynamic experience, it is clear that this cannot be represented by two-dimensional images.  This is important because images are often used to convey landscape and visual effects and, although there is some research that suggests that these can prompt similar responses to those gained when looking at a view on site (Stamps, 1990), a great deal of literature highlights significant limitations. One of the challenges for acceptance of these limitations is that it goes against many people's expectations of current day technology: ie, that surely, with high resolution digital photographs or film and sophisticated visualisation software, it must be possible to mimic our perception and experience of the scale of a landscape.

Rogers (1995) and Berger (1972) highlight that images are not 'real', but are created by people, and thus require to be perceived like everything else, having a dual reality as both an object and a representation of place which requires secondary awareness of the picture's properties. For this reason, Rogers stresses that images have great scope to be ambiguous and to present distorted representations and a key reason why we do not recognise this is because of traditional artistic practice. She adds that artists have long learned how to work with the constraints of images and to use these as an effective medium, but that there is an assumption by many that perception of an image is the same as perception of a real scene, effectively 'a slice of reality' (p119).

Although images contain information similar to that offered by the optic array for real scenes, key constraints are that perspective centres the image on the eye of the viewer and that images require interpretation to recover the third dimension. This is particularly important to perceiving distance which is one of the essential cues to perceiving scale in a landscape. Hawkins and Marsh illustrate very clearly (2001, slides 17 and 18) the importance of perception and interpretation of a scene by comparing a photograph of Cleeve Hill and an artist's painting of this same feature, the former appearing very 'flat' in depth and height compared to the painting[40].

The limitations of photographs and film as well computer simulations based upon these can be difficult for people to understand as they may seem to represent a reality. Rogers (1995) suggests that this has not been helped by a misleading but '*…compelling analogy between the eye and the camera'* which is also explicit in current computer-generated visualisations (p120).

[40] Hawkins and Marsh suggest this is one of the reasons that drawings from photographs never appear as realistic as drawings made whilst observing a subject in real life.

Hawkins and Marsh (2001) describe how many experienced professionals and assessors have learnt to calibrate the differences between what images convey and the qualities of a real view (p8). Nonetheless, even for these experienced people, it is not possible to apply some of the processes and cues for perception (summarised in Table 2.2) when off site and looking at a two-dimensional image or film.

## 2.4 How we perceive scale: the symbolism of scale

The term symbolism is used to describe the use of a symbol to represent ideas or quantities (Oxford English dictionary, 2012). There are many theories and publications regarding symbolism which are not described in detail by this thesis as they do not form the focus of this research. Nonetheless, the following section provides relevant context to how our perception of scale effect is influenced by what scale symbolises to people in the UK.

Lynch and Hack (1984) highlight that symbols are a social creation and thus influenced by cultural, historical and social factors. This also means symbolic qualities may change over time. Importantly, the symbolism of an element can influence perception of whether scale effects are positive or negative and thus the acceptability of these. Johansson and Laike (2007) describe their research findings which showed that people that were positive towards a windfarm tended to focus upon the symbolic attributes, whilst those that were negative towards a windfarm tended to focus upon its adverse visual effects.

A number of authors[41] describe how the symbolism of scale reflects relationships. This is because differences of scale can convey apparent weight and create a hierarchy, with larger elements tending to be perceived as more important or stronger than smaller elements. Jellicoe (1970, p10) highlights some of the cultural associations of large scale, with the following statement:

> "*The giant has a fascination for adults as well as children. If he were at the further end of a beanstalk he would be suitably remote, but if he were a Titan he could leap up mountains to scale the sky and fight for or against the gods... In short the giant is the symbol of awful power*".

[41] For example: de Sausmarez (1964); Ching (1996); Dee (2001).

Similarly, some authors[42] have highlighted the influence of literature on the symbolism of scale as these have used scale to represent power relationships, with the two books quoted commonly being Alice's Adventures in Wonderland[43] and Gulliver's Travels[44].

The construction of large scale structures to symbolise power, importance, strength or wealth are described by a number of authors, including Crowe (1958), Bell (2004) and Tavernor (2004). Bell describes very obvious and deliberate exaggeration of the scale of some structures, for example the oversized statue of Lenin that was constructed in St Petersburg to '*…impress people with the power of the Soviet State'* (p144). Tavernor describes how tall buildings have often been justified on the grounds of land availability, technical, practical or economic reasons, but that a House of Commons committee[45] considering tall structures in London found that '*tall buildings are more often about power, prestige, status and aesthetics than efficient development'* (p82).

Figure 2.15: Differences between the symbolic qualities of large scale structures: Castle Howard (built 1701-09); Chapelcross Nuclear Power Station (completed 1959); Angel of the North (built 1998).

Within the historical context of the symbolism of large structures, a key challenge is to understand how windfarms are currently situated given their contemporary nature (Hough, 1990) and how they may be placed in the future. This is discussed in further detail within section 2.7 on public attitudes.

### *2.4.1 Sculpture and land art*

In addition to the symbolic act of using scale to convey power, wealth or strength, exploration of scale in sculpture has often been undertaken to shock or surprise, to provide

[42] For example: Mallinson (2012) and Sharr (2012)
[43] Written by Lewis Carroll (1865).
[44] Written by Jonathan Swift (1726). The book was known originally as 'Travels into several remote nations of the world'
[45] The House of Commons Transport, Local Government and the Regions Committee. Statement made in 'Tall Buildings: Memoranda submitted to the Urban Affairs Sub-committee, 22 January 2002.

a provocative perspective that prompts people to look closely and examine their expectations (Wells, 2013). This has been carried out using both miniaturisation and enlargement, as well as including normal-sized elements within an enlarged context[46]. For large scale sculptures, Wells describes how exaggeration can highlight the transgression of perceived limits which we might not have been aware of previously, and that this taps into our fascination with resemblances and difference.

Land art is a movement in which the landscape and a work of art are inextricably linked (Weilacher, 1996). Dixon Hunt (1996, p6) describes how this restores an '… *intricate welding of site, sight and insight'*. It is an art form that is usually minimal in design and created in nature using materials sensitive to the surroundings, prompting further contemplation of the setting and wider environmental concepts.

Given that many pieces of sculpture and land art are very large (such as the Angel of the North shown above in Figure 2.15), it is not surprising that people have sometimes questioned the difference between the symbolism of these and other large structures such as wind turbines, telecommunication masts or electricity pylons. Indeed, some have suggested that there can be little difference between these[47] and that designers could manipulate the symbolic qualities of wind turbines to improve positive attitudes towards them.

Scope for energy structures to be seen as sculpture or land-art has been recognised by the Land Art Generator Initiative (n.d.)[48] which promotes the design and development of public art installations that also generate renewable energy. Furthermore, there is a particularly remarkable example by Choi + Shine Architects (2008) of sculptural power-lines. Their proposals for pylons in Iceland adopted a human form which allowed the scale effects of the pylons to be mitigated by the 'giants' adopting different positions that

Figure 2.16: 'The Land of Giants' (reproduced with the permission of Choi + Shine Architects)

[46] Such as Mark Wallinger's Ecce Homo, 1999
[47] For example Gipe (1997) quoting Birt Nielson as saying '*a wind farm can be regarded as a gigantic sculptural element in the landscape, a land-art project if you like*…'
[48] See www.landartgenerator.org

seemed to convey a sensitivity and respect for their surroundings, for example with some 'giants' kneeling and holding 'hands' and some bowing their 'heads' towards nearby settlements.

### 2.4.2 The sublime

When considering the effects of largeness in a landscape, it is useful to reflect on the eighteenth century concept of the sublime. Edmund Burke[49] (2015, p59) describes how '*greatness of dimension is a powerful cause of the sublime*' and John Baillie (1747, s1) highlights that, on experiencing the sublime, '*…every person … is affected with something which as it were extends his very being, and expands it to a kind of immensity*'. To explain further, Mallinson (2012, p112) describes how the sublime developed to capture the '*overwhelming experience of immensity, an experience that could not be grasped by the immediate senses or even through calculation'*.

It is important to highlight that, although largeness or vastness is required to generate feelings of the sublime, it does not follow that a large element such as a wind turbine will necessarily create these feelings. Baillie explains that there are a number of criteria that differentiate perception of the sublime from similar feelings of being impressed by the scale of an element. These include uniformity, allowing a quick glimpse to give an overall impression of vastness without distraction, and he explains (s2) '*where an object is vast, and at the same time uniform, there is to the imagination no limits of its vastness, and the mind runs out into infinity…*' Another requirement for perception of the sublime is unfamiliarity, Baillie stating (s2) *'the grandeur of the heavens seldoms affects us, it is our daily object*.' He observed that, although architecture is sometimes described as sublime, this is typically due to association: ie structures prompt feelings that are similar to those created by the sublime, but these are actually influenced more strongly by a sense of power and grandeur. He states '… *I am apt to think, we sometimes imagine a greater sublime in objects than what there really is'* (s5).

With regards to windfarms, this consideration of the sublime is useful when reflecting upon some of the symbolic qualities prompted by their scale, but also others that are absent. Through this process, wind turbines and windfarms can be recognised as being impressive

[49] 1729-1797

and to prompt a sense of admiration for their scale, engineering and simplicity of form as well as their reflection of sustainability in energy production. Nonetheless, they do not typically push our perception of a landscape and ourselves to a higher level; in the words of Baillie (s1), they do not have an effect that '…*extends his very being, and expands it to a kind of immensity*'. Thus, as suggested by Baillie for other forms of architecture, comparisons between windfarms and the sublime are most likely to be a case of association.

## 2.5 How the design approach to windfarms and other large structures in the landscape has changed over time

This section describes how knowledge and understanding of scale effects has influenced design in the past and continues to input current practice and research.

The approach of Landscape Architects[50] and the public to the design of large structures and spaces has changed over time. Landscape architects were involved in the design of large scale gardens and grounds at least as far back as the Renaissance, but they had less obvious input during the early days of large scale industrial and infrastructural developments during the mid-twentieth century. These included power stations, hydro-electric schemes, electricity transmission lines and pylons, new road systems and forest plantations. The consequences of this lack of involvement were recognised and, eventually, prompted greater attention supported by a more influential town and country planning system in the UK. Key pioneers involved with early work on these projects in the UK were Dame Sylvia Crowe (1956; 1958), Geoffrey Jellicoe (1970; 1995) and Nan Fairbrother (1970)[51].

Fairbrother (1970) highlights that the developments of this time were not only novel, but resulted in a cultural change in people's relationship to the landscape. The extent and speed of this large scale development did not allow for an evolutionary progression by which the landscape 'grew' up from land uses that themselves responded to the specific characteristics of a place and the needs of people. Rather, their extent, speed and superimposition upon the landscape required greater design intervention.

[50] And similar professionals
[51] Other influential work was carried out in parallel within other countries such as the US.

Despite the influential work of landscape architects during the 60's -70's, there was a subsequent trend in landscape architecture practice within rural areas to aim for concealment of large structures, following an approach along the lines of damage limitation, rather than pushing for good design that was not in need of camouflage (Fairbrother, 1970). This tentative approach to conceal large structures was challenged, however, by the arrival of contemporary wind turbines from Denmark and the Netherlands in the early 1990s. Although these were small by current-day standards, at around 50 metres to tip, they certainly couldn't be hidden. Thus, once again, landscape architects were asked to design large scale structures within rural landscapes to have both prominent and positive effect (van Grieken *et al*, 2003).

The first windfarm in the UK was built at Delabole, Cornwall, in December 1991. Around this time, guidance on the landscape and visual effects of wind energy developments was scarce. Some of the national development agencies and electricity boards in addition to regional councils began to produce basic guidance (for example: SWEB and ETSU, 1993; and Cornwall County Council, 1992). Nonetheless, with a lack of examples in the UK to draw upon, the most comprehensive guidance came from the study of windfarms abroad, particularly the Netherlands, Denmark and the US (for example: Lubbers, 1988; Ministry of Energy, Danish Energy Agency, 1990; Pasqualetti and Butler, 1987; Stanton 1993; and Thayer and Hansen, 1988).

Following the tentative approach of the 1980s, some of this early guidance suggested design approaches that contrasted directly with the function of wind turbines, such as keeping structures 'tucked down' off skylines. Nonetheless, in time, greater confidence was conveyed through best practice guidance (for example: Gipe, 1998 and 2002b; SNH, 2001a; Stanton, 1996; University of Newcastle, 2002b) that combined long-established visual design principles with the newly recognised methods[52] of Landscape Character Assessment (LCA) and sensitivity and capacity assessment (SNH and The Countryside Agency, 2002a) and LVIA (The Landscape Institute and IEMA, 1995; 2002). This siting and design guidance continued to develop as additional windfarms were constructed and lessons learned, as there was an increasing requirement for windfarm EIAs to include a

[52] Although long-practiced in a non-standardised manner

design plan (Scottish Executive, 2003) and consider cumulative effects for multiple developments (Pasqualetti, Gipe and Righter, 2002; SNH, 2009; SNH 2014a;).

Over the last two decades, the key design objective adopted for windfarm siting and design has been for developments to 'relate' to the key landscape and visual characteristics of an area (for example: Brittan, 2002a; SNH, 2001a, 2009). For this relationship to appear rational, windfarms have needed to relate to characteristics that are relevant in scale, for example relating 75m high wind turbines to a distinct hill or agricultural landscape pattern (but not to 12m high trees or undulations distinguished by 15m contour lines shown upon a map). Nonetheless, a key challenge now and for the future is to know if or how to follow this same approach and/or achieve this same scale relationship when proposed wind turbines are increasingly larger.

## 2.6 How scale perception influences the experience of windfarms and other large structures

Several research publications describe attributes that influence the perception of windfarms and other large structures in the landscape, such as distance, size and landscape type (for example: Bishop and Miller, 2007; de Vries, de Groot and Boers, 2012; Sustainable Energy Ireland, 2003; and University of Newcastle, 2002b). The scope of this research tends to be limited and variable, as perceptual qualities differ according to the landscape type being experienced (Swanwick, 2009) and because our perception of a landscape is formed through multiple experiences in different circumstances (Lynch and Hack, 1984; The Research Box, LUC and Minter, 2009). Nonetheless, the following section describes some common findings regarding the ways in which the processes and cues for scale perception (described previously in Table 2.2) are applied or demonstrated when experiencing windfarms and other large structures. These are categorised under the following headings:

- The influence of legibility;
- The influence of the perceived scale of spaces, their relationship to people and perceived overbearing effects;
- The influence of distance, elevation and movement of an observer; and
- The influence of wind turbine form.

### 2.6.1 *The influence of legibility*

Although many authors refer to the use of cues to perceive scale within a landscape, the ability to make a scale reference depends on the legibility of this relationship. Turnbull[53] stresses that, as well as it being important for distance cues to be visible, they need to be able to be visually linked between the foreground, midground and skyline of a view so that an object can be placed within the visible context of the landscape. This requirement can mean it is particularly difficult to perceive distance over surfaces which are of similar and/or fine texture, for example the sea, moorland or a forest canopy (Lynch and Hack, 1984).

One of the factors that affect perception of distance of a wind turbine is the combined effect of object recognition and figure - ground. As wind turbines are usually similar in form in Scotland, they tend to be easily recognisable, which can make them more clearly noticeable. Furthermore, where backclothed by land, their clear simplicity of shape and strong colour contrast can counter the expected effects of atmospheric scattering so they are perceived as being closer than their actual distance[54].

Figure 2.17: Clearly recognisable form of wind turbines and their 'figure' emphasised in strong colour contrast to the 'ground' backcloth

As wind turbines tend to be of similar form, the influence of size constancy when perceiving the scale of windfarms at different distances can be difficult to recognise. The resulting scale effect may be that wind turbines are perceived as being the same size over potentially long distance ranges (University of Newcastle, 2002b) or, alternatively, different sized wind turbines are perceived to be the same size, but located at different distances (if this is not indicated by distance indicators)[55].

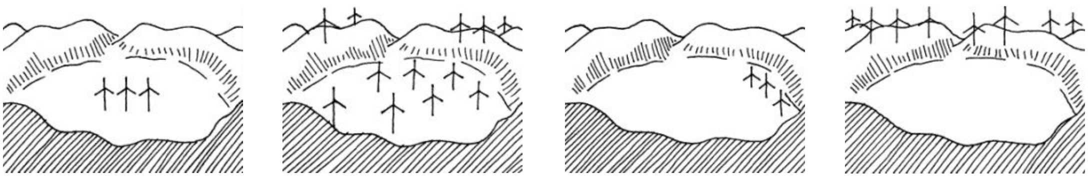
[53] Turnbull, M. (2015) *Scaling an object in a landscape: extract from NPP 4-08-13 for Caroline Stanton* [personal communication, 17 January 2015].
[54] Note, this does not tend to be reflected to the same degree in photographs of wind turbines due to the reduced colour contrast reproduced in an image as compared to that seen by the human eye
[55] The reverse effect of the Eames room shown in Figure 2.6 where it is assumed that the distance of each person is the same and there is perceived strong contrast in size.

A factor that influences the use of cues to make judgements of relative scale is that, as physical sizes increase, larger changes are required for these to be clearly noticeable (Canter, 1974)[56]. In addition, differences of scale may be highlighted or reinforced by related attributes. For example, with regards to wind turbine size, variations in blade length are often emphasised by differences in the apparent speed of blade rotation (particularly obvious where various sized wind turbines are seen in close proximity or overlapping in views).

### *2.6.2 The influence of the perceived scale of spaces, their relationship to people and perceived overbearing effects*

Perception of spaces is a dynamic and elastic process. Thwaites and Simkins (2007) highlight this is because perception of spaces relates to human action. They explain that this means that the scale of spaces has little to do with mathematical geometry and, instead, that we perceive a series of expanding and contracting fields around us.

The scale of a space influences the perceived scale of an object that is located within this as well as the prominence of the object. Fairbrother (1970) states that space needs greater area to register than does mass, whilst Lynch and Hack (1984) highlight that, when perceiving spaces, the horizontal dimension is usually of greater influence than the vertical dimension.



| Prominence of windfarm amplified by enclosure of space | Perceived scale of space encircled by hills influenced by wind turbines dispersed throughout | Windfarm perceived as relating to spatial qualities of space (although other negative effects may occur) | Windfarm perceived to encroach upon spatial qualities of space, although located outwith |
| --- | --- | --- | --- |

Figure 2.18: Different ways in which spatial characteristics can influence the perceived scale effects of a windfarm

[56] In these circumstances, Steven's Power Law can be applied by which the psychological judgement (*p*) is a power function of the magnitude of the physical stimulus (*s*): $p = s^x$ (where $^x$ changes according to the physical variables under examination) (Canter, 1974).

A number of authors have suggested different categories of space perception based on the dimensions of spaces in relation to a human (for example: Dee, 2001; Lynch and Hack, 1984; Motloch, 2001), but these vary in both their terms and sizes[57]. These categorises of space also tend to be more relevant to the design of buildings and urban spaces, rather than objects seen in the countryside such as wind turbines that have effects over very large distances. Nonetheless Motloch does refer to 'superhuman scale', which he describes as monumental space, and 'extra-human scale' spaces which he says are '*… not related to the human, but rather to nature'* (p143).

Where viewers can make a direct scale reference between themselves and elements or characteristics that define a space, the landscape and/or the elements are often described as being of 'human scale'. Noyez (2012) highlights that people tend to get more involved with an object if it is of a human scale, whereas she observes for images that, if you take human references out, it appears more abstract to the observer. Nonetheless, Adler (2012) warns that some people may call for structures to have greater reference to the human scale mainly because they are more comfortable with traditional structures that possess this character.

The perceived effect of an element such as a wind turbine to be overbearing upon a space or a person within a space is primarily based upon the height, width and form of the element as well as its elevation and proximity. This effect is described by various authors using different words, such as 'dominating', 'overbearing' or 'looming'[58] and is usually judged as negative. Hall (1966) says this may be because, in our culture, we often compare imposition to rudeness, like an infringement upon what we consider our 'personal space'. In addition, the perception of an overbearing scale effect depends on the sensitivity of the location and how this is experienced, which may relate to perceived qualities of refuge or shelter. In this respect, SNH (2014a) highlights a particular sensitivity for settlements.

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[57] For example, Motloch (2001) defines different categories of spaces as: intimate (0-18"); personal (18-48"); social (4-12'); and public (12'+).

[58] For example: Haggett, Coleman and Rogers, 2015; Scottish Government Directorate for Planning and Environmental Appeals, 2014.

Crowe (1958) refers to there being a 'zone of scale-domination'[59] (p36 and p45) at close proximity to a large structure. Overbearing effects within this zone are often amplified by the proximity, the influence of visual foreshortening looking up at an element, and because it is not possible to get a complete impression of its total scale.

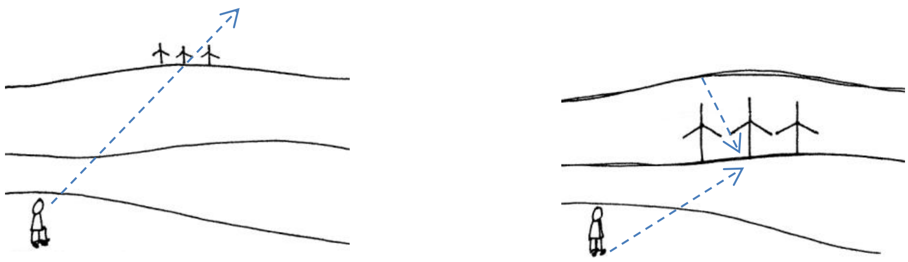
Figure 2.19: Perceived overbearing effect amplified by proximity which also limits the ability to estimate the total scale of the feature

### 2.6.3 *The influence of distance, elevation and movement of an observer*

The distance of an object obviously has an influence on perceived scale effects, although a number of authors have highlighted how landscape and visual effects including scale effects are not directly proportional to the distance of a development (for example: de Vries, de Groot and Boers, 2012; Jones and Eiser, 2010; Scottish Government, 2014b; SNH, 2014a). Some research studies have tried to examine this relationship further, but a key limitation of these have been the distance intervals and ranges at which assessment has taken place, which have not revealed clearly where the thresholds occur for significantly different scale effects influenced by distance. In addition, these studies have not been able to isolate distance from other variables such as the landscape context and field of view.

The perceived scale of an element is influenced by the relative elevation of the observer, with upward views tending to be foreshortened and downhill views appearing more extensive (Lynch and Hack, 1984). This means that the scale of elements often seem amplified where seen elevated above the viewer (National Grid, n.d. 1), whilst they may seem reduced when viewed below the viewer. Nonetheless, the University of Newcastle (2002b) also highlight that, from elevated views, an object seen backclothed in the midground can appear closer because its position is being judged relative to the extent of landscape seen beyond, whilst features upon a skyline are seen against the sky that appears to continue infinitely, as shown in Figure 2.20 overleaf.

[59] Which she suggests diminishes at a distance of approximately three multiples of the height of the element



Windfarm seen upon the skyline is perceived in relation to the seemingly infinite extent of the sky and its perceived distance is based upon only the area between the viewer and the windfarm.

Windfarm seen within midground means its perceived distance is based upon its clear location part-way between the viewer and the skyline.

Figure 2.20: Influence of windfarm location upon perceived distance

In addition to movement through a landscape giving an indication of distance through motion parallax (Table 2.2), travelling through a landscape informs our perception of scale by providing a more extensive experience of the context in which a specific object or place lies (Fairbrother, 1970; Lynch and Hack, 1984).

### *2.6.4 The influence of wind turbine form*

The scale and mass of a structure tends to be emphasised when it is simple or regular in form, without decoration (Le Corbusier, 1927) and, in turn, this also influences its prominence (Shang and Bishop, 2000). Crowe (1958, p12) describes how our perception of an object also depends on its proportions and associations, describing masts extending high into the sky as having '… *grace and lightness [which] gives them an ethereal quality* …'

Wind turbines in Scotland are clearly recognisable due to their similarity of form, colour and distinctive blade rotation (which also highlights their function). This means that, following object recognition, their perceived scale is influenced by prior knowledge, even if a windfarm is not completely visible, for example due to partial screening by woodland (University of Newcastle, 2002b). Applying prior knowledge may include making scale reference to what is considered 'normal' in scale for wind turbines within a distinct area.

## 2.7 How scale perception influences public attitudes to and preferences for windfarms and vice versa

There is a large body of literature on public attitudes to and preferences for windfarms. A significant proportion of this focuses upon subjects such as community awareness, involvement and acceptance of schemes and what is termed the 'social gap': the difference between general high public support for wind energy, but relatively low numbers of constructed windfarms following planning consent (Bell *et al*, 2005). Consequently, only a selection of this material is directly relevant to this research, primarily those attitudes or preferences that would affect the perception of the scale and scale effects of a windfarm within a landscape.

The terms attitudes and preferences have different meanings, as set out by Swanwick (2009, s63) who defines attitude as '*a deeply held mental stance*' whilst preference means '*liking one area of land or landscape better than another*.' Nonetheless, these terms are frequently used ambiguously or interchangeably within the literature concerning windfarms and the landscape. Consequently, for the purposes of this thesis, the term 'attitude' is used to encompass both attitudes and preferences as defined by Swanwick unless otherwise defined in the text or where authors are directly quoted.

Attitudes to windfarms are complex. This is not only because opinion varies between different people, as might be expected, but also because people may have a number of different attitudes to developments responding to different contexts (Johansson and Laike, 2007). It is also suggested by several authors[60] that public attitudes vary because windfarms do not occupy an obvious niche within our landscape or society. Unlike the wind pumps or windmills of the past, they are not distinctly agricultural or industrial in character and, because of the predominant high wind speeds across the UK[61] and dispersed nature of our National Grid, are not linked to any distinct type of landscape or community.

With regards to public attitudes in general, Swanwick (2009) stresses that it is impossible to consider society's attitudes to the landscape as a whole and that attitudes will vary between communities. Nonetheless, although most research studies acknowledge the

[60] For example: Brittan (2002b), Hough (1990) and Selman (2010).
[61] Environmental Change Institute, 2005

complexity of factors that influence people's attitudes to windfarms, a number of commentators still make misleading statements that imply the subject is simple and binary, so people may feel pushed to 'take sides'. An example of this is the statement: '*we seem to have something of a love-hate relationship with windfarms*' (All in the Mind, 2013), despite this headline being followed by a useful description of a number of different factors affecting perception of windfarms. Following this 'for' or 'against' approach, there has often been insufficient consideration of the attitudes that lie part-way in-between which are often judged as being indecisive or uninterested (Braunholtz, 2003). In contrast, this position may include those that are most thoughtful and reflective, for example having an opinion that varies in relation to the siting and design of different schemes. Selman (2010) also highlights an important distinction: that there is a difference between attitudes to effects and attitudes to the acceptability of effects. He explains this is because attitudes are dynamic and that attitudes to new types of energy production may eventually gain greater support from society, so the same level of effect may over time prompt a different judgement of acceptability.

One of the limitations to understanding attitudes to windfarm scale effects has been how to engage people across a windfarm's study area. So far, there have been two main approaches to studies seeking information on attitudes: one has been to study in detail a local community and development (proposed or existing), with which there is close liaison and participation with local people[62]; and two, to survey over a more extensive area using questionnaires delivered by post or over the telephone[63]. With the first type of study, an advantage tends to be the ability to gather very detailed data that can provide great insight into the perceived qualities and values of the landscape and visual baseline as well as the effects of any development, but a significant limitation is the typical small number of participants and study area, thus limiting the applicability of the findings elsewhere. In contrast, the second type of study can gather responses from a more extensive area, but it tends to be very difficult to engage people in such an impersonal manner (especially if many participants do not understand the subject), and to be able to communicate clearly the issues on which information is required. There have also been a number of alternative

[62] For example the project 'People, place and community: the missing chapter' carried out by Haggett, Coleman and Hodges for Creative Scotland and SNH (2015).
[63] For example a recent study of attitudes to ten existing windfarms carried out by SLR and Hoare Lea Acoustics for ClimateXChange (2015)

approaches to exploring public attitudes to windfarms that have incorporated various arts, for example the 'Tilting at Windmills' project by Jess Allen[64]. For this, Allen walked 100 miles between existing windfarms across mid Wales, combining artistic expression with experiential assessment and recording the opinions of different people that she met en route.

Since the 1990s a number of research projects have been carried out to understand better the apparent 'social gap'. In the past, there were suggestions that this was the result of NIMBYism[65] but, following a number of research studies[66], it has been concluded that labelling all opponents as NIMBYs is too simplistic and ignores a number of different multi-faceted reasons for opposition (Bell, Gray and Haggett, 2005; Bell *et al*, 2013; Devine-Wright, 2005; Warren and McFadyen, 2010; and Wolsink, 2000, 2007). Wolsink explains that, although '*the NIMBY concept is often considered as 'common sense', it actually represents a specific dilemma or game situation'* (2000, p51) and Bell *et al* judge that NIMBYs are actually rare.

Haggett (2004) found that, although people had assumed that the 'social gap' was because of people's fear of having a development close to where they lived, their opposition was instead more likely to be because of the innate value they placed on a particular landscape. Furthermore, she highlighted that the specific characteristics of a development were important to attitudes, including the number of wind turbines, their height, layout and design, as well as public *involvement* in a scheme (not just consultation). Following this study, Bell, Gray and Haggett explored further in 2005 and 2013[67] the types of reasons that may be responsible for the 'social gap'. They identified four main types, with one of these being particularly relevant to this research: the 'qualified supporter'. This is somebody who supports wind energy development, but feels there are limits and controls required. This means, if their qualification relates to sensitivity to scale effects, there may be scope through the siting and design of windfarms to influence their support. Nonetheless, Bell *et al* (2013) warn that addressing the concerns of qualified supporters may not be easy, as it

[64] Allen (n.d.), *Tilting at windmills* (2010) and *The making of Tilting at windmills* (2010)
[65] Acronym for 'Not In My Back Yard', used commonly to mean a person who is supportive of wind energy development in principle, but against schemes near to their home.
[66] For example: Warren *et al,* 2005; Haggett, 2004; Bell, Gray and Haggett, 2005.
[67] This follow-up study from the first in 2005 was also co-authored by Swaffield

requires these to be able to explain or convey the nature of their qualifications and also to know or recognise the thresholds required to satisfy them.

Although many studies report that public attitudes relate to the characteristics of a landscape, development and community, there have been remarkably few that have explored how public attitudes and perception relate to the landscape and visual effects of different kinds of windfarm in different landscapes. Furthermore, there have been even fewer that have explored the perception of scale effects within this framework. This may be explained in part by most of these studies being based on the first and second generation wind turbines (typically up to 65m to tip) for which scale was not such a great problem (Eltham, Harrison and Allen, 2008).

From the review of existing studies on public attitudes to windfarms, key factors relevant to this research are summarised below.

a Public attitudes are context specific and influenced by social and cultural characteristics, with multiple factors interacting to influence perception (Bell *et al,* 2013; Devine-Wright, 2005; Selman, 2010; Warren and McFadyen, 2010).

b The greatest influences on attitudes to a specific windfarm are how this relates to the landscape and visual resource and the perceived value of this (Devine-Wright, 2005; Gipe, 2002b; Johansson and Laike, 2007; Warren *et al*, 2005; Warren and McFadyen, 2010; Wolsink, 2000, 2007). This is influenced by the scale and design of the windfarm (Sustainable Energy Ireland, 2003), although it is suggested by some authors that the characteristics of a windfarm are less important than the landscape and visual resource (Eltham, Harrison and Allen, 2008).

c The relationship between attitudes and demographic characteristics are variable between studies and tend to only be significant when combined with landscape attributes (Molnarova *et al*, 2012). The main exception is age, with a few studies identifying a correlation between negative attitudes and increased age (Coleby, Miller and Aspinall, 2009; Sustainable Energy Ireland, 2003).

d Whilst some studies have suggested that public attitudes were more positive with increased familiarity of seeing or living with windfarms (Braunholtz, 2003; Warren and Lumsden, 2008), other research has found the opposite (Sustainable Energy

Ireland, 2003), so variability of evidence means the link to familiarity is inconclusive (Bishop and Miller, 2007; Devine-Wright, 2005).

e Evidence linking attitudes with proximity to windfarms is variable and inconclusive (Gipe, 2002a; Johansson and Laike, 2007; Molnarova *et al*, 2012; Warren and Lumsden, 2008). The influence of proximity on attitudes seems to be linked to perceived intrusion (Coleby, Miller and Aspinall, 2009; Wolsink, 2000 and 2007).

## 2.8 Thresholds of scale effect and the judgement of compatibility

When judging the acceptability of scale effects, there is common reference to whether a development is '*in scale*' or '*out of scale',* but there is typically no definition provided of what these mean or where the threshold lies in-between them. It is surprising that clarity is not provided in this respect given the importance of scale effects and the misunderstanding that ambiguity can bring. Adler (2012, p1) suggests that this may be because we assume that we know what it is to be in scale or out of scale. He states: '*scale seems to be such a commonplace [sic] in an architect's armoury that it is very much taken for granted'*. In addition, Wells (2013, pxiv) states '*scale itself is a concept that is as familiar as it is undefined. Used regularly, it is rarely accompanied by an accurate definition'*.

Although largely undefined, review of literature that includes descriptions of being in or out of scale reveals a common reference to perceived *compatibility* between an element and its surroundings. This follows a similar design approach to that typically included in LCA, LVIA and landscape capacity studies, often described as 'fitting' a development with a landscape. For example, SNH and The Countryside Agency (2002b) describe an aim to accommodate change within a landscape without significant effects on its character or overall change of a landscape character type, whilst Swanwick, Gillespies and LUC (2014, p24) refer to 'the degree of contrast, or integration…' with '… the wider visual context…' regarding scale.

Although there are many guidance documents that advocate a compatibility approach, there has been little research on this topic with respect to the scale effects of large structures[68]. Nonetheless, there has been some useful research published on the

[68] possibly because there is an assumption that this is commonly understood (like designing in scale)

compatibility of housing scales by Nasar and Stamps (2009), including study of what are called 'McMansions': oversized houses with which an analogy is drawn with the enormous sandwiches sold by fast-food outlet McDonalds. Through this research, Nasar and Stamps found that people have greater preference for houses that are compatible in form and scale and confirmed that the size ratio with neighbouring structures is more important than absolute size, with ratings of visual preference increased where houses were limited to less than twice the size of adjacent structures. Furthermore, Stamps (1994) found that respondents preferred either all large or small houses on a block and that, even if people liked one particular house style, their preference for this was removed if it contrasted to other houses within an area. This judgement of compatibility was also revealed to adjust over time. For example, the introduction of one large house within a block of smaller houses prompted a negative response but, after this was introduced, preferences then flipped to be for more large additions to improve the perceived integration of the isolated 'stranger'[69].

### *2.8.1 Compatibility of the scale of windfarms*

Although compatibility of windfarm scale is supported through good practice guidance[70], it is important to highlight that this covers two different aspects: compatibility between different wind turbines and windfarms; and compatibility with other characteristics of the surrounding landscape. The first requirement for compatibility between different wind turbines and windfarms is fairly straightforward to define, as it involves reference to existing or proposed windfarms within an area (although complications can occur if these are already of various scale and have planning consent over different timescales[71]). The main reason for advocating compatibility in this respect is to minimise visual complexity or confusion resulting from varying wind turbine or windfarm scale which can appear

[69] Stamps (2002) also carried out research to examine whether fractal ratios may be relevant to this preference, but found this to be no more important than general compatibility with the scale and pattern of the surrounding landscape.
[70] For example SNH, 2014a;
[71] In the UK wind turbines typically have a working life and planning consent of 20-25 years. So, as an example, there may be existing windfarms of 50m to tip and 100m to tip within an area with remaining lifespans of 5 and 15 years respectively. Whilst it might be decided that the 50m to tip turbines are more appropriate in scale, these may be re-powered to have larger wind turbines in 5 years' time, perhaps to 100m. Thus, by matching a new windfarm to the original 50m wind turbines, the lack of compatibility of scale would persist.

irrational if there is no obvious visible justification for the differences[72]. This was supported in 2014 by a Scottish Government Reporter (Scottish Government Directorate for Planning and Environmental Appeals, p3) who described how a difference of wind turbine size and rotor diameter between two neighbouring windfarms would appear '*discordant, distracting and ultimately disturbing*'.

The second requirement for compatibility, between a windfarm and a landscape, is much more difficult to satisfy. If windfarms are disparate in scale to other existing structures within an area, there is no option to go with the most straightforward and 'safest' design choice of matching what already exists. This leads to the important question: *With what in a landscape should a windfarm be compatible in scale?*

Moore and Allen (1976) say the question of compatibility can only be answered by understanding what scale relationship is most relevant and important. They explain this point with the following example (p24): If you have a room where everything is 'normal' except an oversized fireplace, what is the reference? Rather than the fireplace being out of scale, could this in fact be part of a larger whole which cannot be seen with which it is compatible and it is in fact the minor details of the room that are incongruous?

Contesse (2011) describes how, given their size, wind turbines tend to be larger than other landscape components. So, following Moore and Allen's example above, their scale effects may relate less strongly to their immediate surroundings and more strongly in reference to the broader scale landscape context. In many cases in practice, this has been the design approach adopted for large windfarms: to relate these to broad level landscape characteristics. Nonetheless, this raises another issue: if a windfarm relates to the wider landscape, what does this mean for the local landscape and the people within this if the windfarm has an overbearing scale effect upon them? This highlights the difficulty of achieving compatibility of scale at various levels within a landscape.

[72] Even if the differences derive from good reasons, for example differences of ownership between individuals, communities or large companies.

Compatibility of small windfarm with scale of settlement

Compatibility of large windfarm with wider landform, but incompatible with scale of settlement

Figure 2.21: Alternative compatibilities of scale between a windfarm and the surrounding landscape and visual receptors

Exploring the challenge of determining with what a new structure should be compatible, Craik (1986, p52) explains there is an alternative approach to just replicating 'neighbours', which is to relate to the 'architectural vocabulary' of a region (whilst ignoring the neighbours). Nonetheless, for both approaches, Craik warns that a judgement of compatibility will depend upon the observers' ability '…*to abstract certain features of a structure and link them to comparable but not identical features of nearby or widely dispersed structures'*. Given this requirement, it is likely that the ease of making this judgement will depend upon the character and legibility of the surrounding landscape and how it is experienced as well as the skills of the observer.

When describing the compatibility of scale effects, the focus is often on the extremes: what is clearly compatible or incompatible. Nonetheless, a challenge for practitioners is also to make judgements across the range of scale effects (Fraser, 2010). This requires thresholds to be identified between either ends of the spectrum where the type of scale effect changes significantly.

#### 2.8.1.1 Where compatibility is not desired

Despite the common aim for compatibility, it is important to highlight that this may not always be desired. Indeed, there are many examples where compatibility has not been required, such as for large manor houses, sculptures or towers (raised previously within section 2.4 on symbolism). Crowe (1958, p46) highlights that the context of these structures is very important. Whilst compatibility may not be sought, they nonetheless require a '*zone of complete simplicity'* to separate them from surrounding elements to avoid appearing to clash in scale and appear overbearing.  She also warns that this buffer effect will fail if it is breached by intervening elements that act as '*stepping-stones to the eyes'* and thereby link conflicting scales.

Similar to the need for a horizontal buffer between contrasting scales, a possibility suggested by some practitioners[73] is that vertical separation between extremely tall wind turbines and the underlying landscape may allow these to seem detached and not overbearing upon a smaller scale landscape below.  This can be compared to the perceived detachment of an aeroplane flying through the sky above.   Crowe (1958) supports the feasibility of this approach, although she adds the warning that, if it is taken, it is important to not 'humanize' structures or provide a scale reference so that their perceived separation is maintained (p17;p49).

### *2.8.2 Defining the thresholds for acceptability of scale effects*

Following the process of LVIA and EIA (Landscape Institute and IEMA, 2013), there is an important difference between judging the magnitude of scale effects and the significance of scale effects (which may include assessing that a wind turbine is compatible in scale) and judging the acceptability of these effects.  This is because a judgement of acceptability relies on qualification: being acceptable in relation to a specific policy.  In Scotland, key planning policies are applied at a national level by Scottish Government and SNH, and at a regional level by the local planning authority.

Scottish Planning Policy (SPP) (Scottish Government, 2014a) mentions scale in a number of places with regards to the acceptability of a development, for example:  '*Planning permission should be refused where the nature or scale of proposed development would have an unacceptable impact on the natural environment*.' (SPP paragraph 203, p47).  Scottish Government (2014b) also state that SNH guidance (2014a) should be followed and this includes advice such as: '*…large wind turbines will appear out of scale and visually dominant in lowland, settled, or smaller-scale landscapes, which are often characterised by the relatively "human scale" of buildings and features'* (p8).

[73] Discussion between participants of CPD event for Landscape Institute North East branch, held 17 March 2015.

Unfortunately the thresholds for acceptability of scale effects described by planning policies and guidelines tend to be ambiguous, as they do not typically include definitions of the terms used or they apply imprecise qualifications such as to 'respect' a certain aspect. Stamps (1994, p226) highlights that anthropomorphic expressions of effect such as these can be unhelpful when describing relationships of a development to the baseline, as expressions such as 'respect' describe the activity of a living being.

When considering the thresholds of different effects, it is also important to take into account incremental change. The level of scale effect is usually assessed in relation to the baseline conditions but, if repeated developments have occurred over time, this baseline will have changed and it is important to consider cumulative effects.

## 2.9 Review of theoretical background and literature to address the problem statement

From the review of literature described by this chapter, it was revealed that there is a wealth of information on vision, visibility, visual perception and aesthetic proportion systems which is long-established and detailed, in addition to a large amount of more recent research on public attitudes to windfarms. Nonetheless there are limitations and gaps in the range of literature relevant to the perception of scale and scale effects in the landscape. These are summarised below.

### The perception of scale and the types of scale and scale effect

1 Although a large amount of existing information exists on vision, visibility and visual perception, there is relatively little material on how to apply this to landscape architecture[74] and, specifically, scale effects in a landscape, for example the influence of scale constancy and scale reference. In addition, the material which does exist tends to be fragmented and piecemeal in subject matter[75], which means that it is difficult to understand how different aspects combine to influence the overall experience of scale in a landscape.

2 Past research studies have often focused upon whether different scales of structure are visible or not, prominent or not, or are judged as changing the underlying scenic

[74] Although exceptions include: Bell, 1999, 2004; Ching, 1996; Dee, 2001.
[75] This may be partly because it has been drawn from a range of case studies in various landscapes in which different issues have been encountered

value or not, with little exploration of the nature of landscape or visual effects perceived when a windfarm is seen.

3 As the major proportion of existing literature concerning visual perception of scale is situated within the discipline of architecture, references to scale typically concern the relationship between people and buildings and rarely address the additional scale relationship between people, structures and the wider landscape, or directly between people and the landscape. This is also the case for the categorisation of scale-space relationships, with most categories identified to date being related to small scale and/or urban environments.

4 Past research and guidance documents have often focused upon the visual scale effects of windfarms, rather than the spatial scale effects of schemes and how these are experienced. Furthermore, these have often considered in a rather abstract way *what* changes there will be to the visual composition of a view, rather than explaining *how* and *why* this will affect the people that will experience the changes. Specifically, there has been little research on how scale effects are influenced by the scale of spaces and how these are experienced, linked to concepts of place and perceived refuge or sanctuary.

5 There is a relatively large amount of published literature on concepts such as the sublime and the symbolism of scale, but there is little information on how different scales of windfarm can achieve positive symbolic qualities (apart from via community ownership) comparable to land art or sculpture[76].

### Combinations of attributes and their experience

6 The majority of studies highlight the importance of landscape type and context to landscape perceptions, which also applies to the perception of scale and scale effect. Nonetheless, there is little material on how the different characteristics of landscapes and the experience of these by people combine to influence perception of the scale effects of windfarms. Alternatively, research studies have tended to focus upon preferences for just separate aspects which are quantifiable (such as height and number of wind turbines).

[76] Although the Land Art Generator Initiative (n.d.) has broached the subject in general

7 There has been very little research on how attributes combine to contribute to a perception of an overbearing scale effect, for example incorporating height, elevation or proximity.

8 Past research studies that have explored public attitudes to windfarms have typically focused upon different people's judgements of windfarms as a single type, with little exploration of why certain perceptions occur and, specifically, how these correlate to the variables of windfarm design (such as wind turbine scale) and how these are experienced in different landscapes. Additionally, where alternative windfarm types and locations have been considered, the categories of the different types, for example proximity, have usually not been selected to reflect or respond to different thresholds of effect. This means that the findings have often been inconsistent.

### Robustness of methods and ambiguity of references

9 Many studies use landscape and visual terms ambiguously and undefined when describing baseline conditions or levels of change or effect (which may be partly because the authors of the research come from a range of different disciplines). This means that it is difficult to compare the findings of different studies and carry out meta-analyses. Discrete aspects of landscape architecture that several authors confuse are: visibility extent with the nature of visibility or visual effects; the character, value or quality of baseline conditions; the sensitivity of a baseline resource with its value or quality; and magnitude, significance and acceptability of effects.

10 Although some studies have identified different scale effects and some guidance and policy documents recommend certain levels of acceptability (for example to be in scale with the baseline landscape), the different levels and their thresholds are usually undefined. Conversely, these aims tend to be very generic, with little information on how they can be achieved and how they may change over time.

11 Past research studies have often relied upon photographs or photomontages as a tool to measure different people's perceptions and judgements of scale effect, despite these being limited in how these can represent scale effects experienced in the field. In contrast, very few studies have researched people's perception of scale whilst out in the field and moving through landscapes.

12 There is little combination or cross-over between academic studies and good practice guidance or planning policy[77] which means that many studies do not combine the benefits of academic methods and knowledge with an understanding of assessment methods, design and planning practice.

### Application to present day

13 A significant proportion of existing research specific to windfarms in the UK, continental Europe and the US is dated, based on first or second generation wind turbines up to about 65m high to tip. There is a significant gap in research based on current and future proposals that are typically up to 150m high at present and are likely to increase further.

## 2.10 Research questions and hypotheses

In response to the problem statement identified in chapter 1 and the theoretical background described by this chapter, the following research questions were identified as needing to be addressed:

- *How do people perceive the scale effects of windfarms in a landscape?*

  This includes the following contributory questions:

  - *How do different scales of windfarm in different landscapes create different scale effects?*
  - *How can we site and design windfarms to minimise adverse scale effects?*
  - *How can we best assess the scale effects of windfarms in the landscape?*
  - *How can we best communicate scale effects to different people?*

In addition to these research questions a number of hypotheses were identified as listed below. These represented key issues that were being raised in practice.

a Different wind turbine sizes and numbers result in different scale effects within different landscape types, with thresholds occurring between these (illustrated by Figure 2.22 overleaf);

[77] An exception is the Visual assessment of windfarms: Best practice (University of Newcastle, 2002b).

b People's perception of scale effect relates closely to their experience of a landscape;

c People's perception of the scale effect of windfarms relates to the proximity of a windfarm, the scale of a windfarm, the character of the landscape and people's attitudes to windfarms;

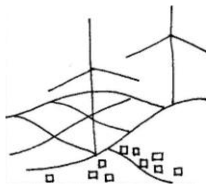
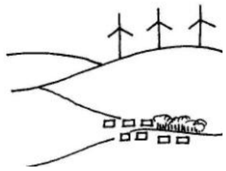
d Wind turbines that appear out of scale within the landscape will typically have significant adverse landscape and visual effects (although exceptions may occur where they are perceived as a positive symbol for a community);

e Perception of scale effects change over time in relation to the range of scales of structures that occur within a landscape and that have been experienced by people; and

f Typical applications of standard LVIA methods (as part of EIA) do not adequately convey the scale effects of a proposed windfarm.

The following chapters 3 and 4 will outline how these research questions and hypotheses can be addressed through different research methods.

Figure 2.22: Diagram illustrating hypothesis a: different wind turbine sizes and numbers result in different scale effects within different landscape types, with thresholds occurring between these.

| **Scale effect** | | | |
|---|---|---|---|
| **Level**[*2] | Type of effect[*2] | | |
| **High** | 'Overbearing' |  | Where a windfarm is 'out of scale' and is not compatible with other built features or the spatial characteristics of the landscape and is overbearing upon the experience of the landscape and its qualities and value perceived by the community*[1]. |
| **Medium** | 'Balanced' |  | Where a windfarm is 'in scale' and is compatible with the scale of other built features or the spatial characteristics of the landscape. Although prominent as a distinctive feature, it is not overbearing upon the experience of the landscape and its qualities and value perceived by the community*[1]. |
| **Low** | 'Modest' |  | Where a windfarm is 'in scale' and is compatible with the scale of other built features and the spatial characteristics of the landscape. It appears similar in prominence to other elements and is not overbearing upon the experience of the landscape and its qualities and value perceived by the community*[1]. |

***Notes***

**[1]The community relevant to the scale effects of a windfarm may be communities of place and/or interest and may vary for different schemes. The study area needs to be determined to include those areas in which people are likely to experience significant scale effects.*

**[2] Following this hypothesis, an increase or decrease of wind turbine size or numbers do not necessarily result in a change of type of scale effect; this depends on whether the change takes the scale effect across the threshold into a different type. The thresholds of effect occur at different levels for different sizes and numbers of wind turbines within different landscape types.*

*These types of scale effect may result from a single wind turbine, numerous wind turbines within a single group, or multiple single wind turbines or windfarms.*

## Reflections on Section A: Research background and theoretical background

This section of the thesis that includes chapters 1 and 2 has described the background to the research: what the problem is; why it exists; and a review of existing literature to inform the research and provide a foundation upon which it can build.

Whilst scale is very important to how we perceive our surroundings, this section has described how a problem occurs because people find it difficult to predict and convey the scale effects of large structures proposed in a landscape. Taking windfarms as a development type, this section has identified the scope of this problem, influenced by the increasing disparity of scale of windfarms with other elements in our landscape and a difficulty of demonstrating potential scale effects. This section has also described why the problem needs to be addressed.

Following analysis of the problem statement, this section has included a review of relevant literature. This revealed that there is a large amount of long-established material concerning vision, visual perception and proportion systems, and this provides a good base for understanding perception of scale in general. Nonetheless, the review also revealed gaps in the theoretical background, particularly with regards to how the different influences on perception of scale combine and are experienced in different landscapes by different people, and how thresholds of scale effect are judged.

Exploration of both the problem statement and theoretical background has highlighted the importance of communication. This is not only relevant with regards to the words being used to describe scale and scale effects, but also the type of scale effect being described and what scale references are being used, including when judging compatibility.

Based upon the research background and the theoretical background, research questions were identified at the end of this section in addition to hypotheses. These are taken forward to inform development of a methodology framework and the selection of individual research methods described by the following section B.

## Section B: Research strategy and methodology

# Chapter 3

# METHODOLOGY FRAMEWORK

To address the research questions and hypotheses, a methodology framework was developed. This is described in the following chapter, which sets out the scope of the research as well as subjects not addressed. The individual methods are described in greater detail within chapter 4.

### 3.1 Selection of methods and their combination

Exploration of potential research methods to address the research questions revealed, not surprisingly, that different methods had various advantages and disadvantages. Taking into account gaps in knowledge and difficulties encountered in practice (described previously in chapters 1 and 2), it was judged that the methods to adopt needed to:

- Explore and/or develop new methods to understand perception of scale effects, assess scale effects and/or communicate the nature of scale effects.
- Address some of the limitations and deficiencies of existing assessment methods;
- Relate to how landscape and visual effects are assessed in landscape architecture practice (partly so that the research could include review of assessments that had been completed in the past for developments that had since been constructed, but also to ensure the findings would be relevant for application in the future by practitioners).

Some aspects of scale effect or methods of assessment were excluded from this research, as described later in 3.3.

Following the process of exploration described above, it was judged that three methods should be used for the research, as shown overleaf in Figure 3.1: Landscape and Visual Impact Assessment (LVIA); experiential landscape assessment; and public attitude and preference study. Each of these methods brought their own benefits and limitations, but it was the combination of all three that was of most value in addressing the research questions, with aspects of each method complementing, linking , overlapping and/or bridging the gaps of the others.  Another advantage of using these three different methods was the ability to evaluate the relative effectiveness of each to assess scale effects in different ways.

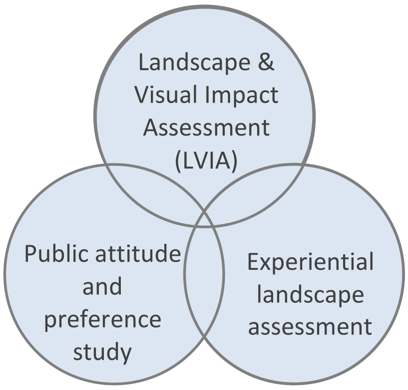



Figure 3.1:  Combination of research methods

Within the structure of landscape architecture research laid out by Deming and Swaffield (2011), this research framework most closely follows a constructionist strategy, taking an epistemological approach that includes both objective and subjective aspects.  This means that landscape knowledge was actively constructed, and had to always be interpreted in its context.

The combination of research methods can also be categorised as 'multiple methods'. Symonds and Gerard (2008) describe this as the use of numerous methods to achieve triangulation without the restrictions of particular paradigms or methodological categories, and where the results of these methods are reported separately.

The framework for the research methodology is shown in Figure 3.2 overleaf.  This reveals that, for each method, there are inductive, reflexive and deductive stages following Deming and Swaffield's categorisation:  starting with description, leading to classification and, finally, undertaking evaluation to address the research questions.  Throughout this research, the reflexive approach taken involved repeated identifying, exploring, reviewing, and adapting the methods in light of ongoing findings and improved understanding.

The following section summarises each of the methods (described in greater detail within chapter 4).

### 3.1.1 Landscape and Visual Impact Assessment (LVIA)

The process of landscape and visual assessment is long-established in landscape architecture, following a basic procedure of analysis of baseline characteristics, consideration of alternative proposals for siting and design, and assessing predicted residual effects (both positive and negative). Nonetheless, in 1995, a more standardised process, titled 'Landscape and Visual Impact Assessment' (LVIA) was established through publication of the Guidelines for Landscape and Visual Impact Assessment (GLVIA) by the Landscape Institute and Institute of Environmental Assessment[78]. This was followed by a second edition published in 2002, and the current third edition published in 2013. This method has now been adopted by most Landscape Architects in practice within the UK to assess and design landscape change or developments that are likely to result in significant effects[79]. It comprises in its most basic form a three-pronged approach to assessing a proposal in terms of the sensitivity of the landscape and visual resource, the magnitude of effects, and the significance of landscape and visual effects.

Use of LVIA within the methodology framework for this research does not include production of a LVIA report itself. Conversely, the process involves critical review and assessment to identify the scope of LVIA (following GLVIA) to assess scale effects, how scale effects have been assessed by LVIAs produced in the past, and what sensitivities to scale effects need to be considered by LVIA in the future.

### 3.1.2 Experiential landscape assessment

Experiential landscape is a term used to describe the holistic relationship between outdoor spaces and the range of human experience (Thwaites and Simkins, 2007). Assessment of this relationship is not new in landscape architecture and has been undertaken in various forms over time, including sequential 'view from the road' assessments that gained popularity in the 1960s and 70s (for example Appleyard, Lynch and Myer, 1964; University of Edinburgh, 1974) and urban spatial analysis (Lynch, 1960), as well as more contemporary

[78] This became later in 1999 the Institute of Environmental Management and Assessment
[79] As defined in GLVIA

methods of behavioural mapping, way marking and experiential landscape mapping (for example: Moore and Cosco, 2010; Thwaites and Simkins, 2007; Ward Thompson, 2010).

Experiential landscape assessment has often been overlooked in recent years within conventional landscape architecture practice, as uptake of LVIA has increased (due partly to its recognition in British planning policy and regulations). Furthermore, as there is no single or standard method of experiential landscape assessment, its distinction in practice has often been under-recognised. Nevertheless, a notable body of published literature describes a common approach to experiential landscape assessment. Principally, it includes consideration of the dynamic experience of the landscape, recognising that this embodies both perception of the landscape and personal involvement and activity within this. In this way, experiential landscape assessment provides a link between the spatial and structural properties of a landscape and human behaviour (Ward Thompson, 2010) and recognises the need to consider affordances (Heft, 2010).

### *3.1.3 Public attitude and preference study*

Public attitude and preference study is a generic term that can include a large number of different methods. Under this umbrella, the methods selected for this research were chosen specifically to address the research questions, building upon existing knowledge of public attitudes to wind energy development. Key aspects of the research questions to be addressed were how people perceive the scale effect of windfarms and the best way to communicate scale effects. As shown in the research methods framework in Figure 3.2, the public attitude and preference study included two questionnaires.

Determining the research methods for the public attitude and preference study required a significant amount of exploration and analysis. This was principally because: attitudes are strongly affected by the context of any development and people's attitudes to windfarms (Haggett, 2004; Warren *et al*, 2005; Wolsink, 2007); there was a need to frame enquiries so that a respondent was not unduly led by questions; and participants were not always able to understand, formulate or communicate easily or clearly their judgements.

### 3.1.4 Advantages and disadvantages of the individual methods

The following Table 3.1 summarises some of the advantages and disadvantages of each of the three research methods. These were identified during the early stages of the research through review of completed assessments and published literature. It should be highlighted that these advantages and disadvantages were identified following review of how the methods were carried out in common practice, even though some of these methods possess scope to alleviate or avoid some of the disadvantages described (for example there is scope within LVIA to consider effects in a joined-up manner, not just separately, but this was found to be done infrequently).

Table 3.1: Summary of advantages and disadvantages of the different research methods for assessing scale effects

| *Method* | *Advantages when assessing scale effect* | *Disadvantages when assessing scale effect* |
|---|---|---|
| LVIA | • Standard and clear structure to method.<br>• Method carried out commonly in landscape architecture practice and familiar to many environmental professionals.<br>• Separation of characteristics can help understand contribution of separate components and different effects on different receptors.<br>• Presentation of clear criteria for effects, and clear distinction between existing baseline and future changes.<br>• Adjustable to different study areas, including the ability to apply to extensive areas. | • LVIAS often present information in a fragmented and complex manner, so combined effects and the relative importance of these is often 'lost'.<br>• There is often focus on physical landscape features or views from specific points, with inadequate consideration of the experience of the landscape.<br>• There is often focus on data description rather than analysis and interpretation (the 'so what?').<br>• Communication of predicted effects often uses language or images that are unclear and/or don't represent how people typically experience a landscape. |
| Experiential landscape assessment | • Takes into account dynamic experience of the landscape and perceiving-action process.<br>• Link between spatial and structural properties of the landscape and human behaviour.<br>• People tend to engage in and understand the method and findings, as they can relate these to their experience of the local landscape as a composite (rather than as separate elements).<br>• Process aids understanding of the relative importance of characteristics by considering these together.<br>• Flexibility of method (also disadvantage opposite), facilitating | • Not used widely in conventional landscape assessment practice, at a broad scale, or as part of EIA, so many practitioners and planners are unfamiliar with the method.<br>• Typically resource intensive due to time required to involve members of a community as well as professionals. For this reason, tends to be limited to small geographical areas or narrow subject matter.<br>• No standard method (also advantage opposite), so need to establish at outset and adapt this for each project. |

| Table 3.1: Summary of advantages and disadvantages of the different research methods for assessing scale effects | | |
|---|---|---|
| *Method* | *Advantages when assessing scale effect* | *Disadvantages when assessing scale effect* |
| | adaption to site and people-specific issues.<br>• Interviews with participants allow greater explanation of issues and standard questions can be couched differently for individuals.<br>• Group interviews may lead to more responses, giving individuals the confidence to speak up (some may not offer individual response, but express opinion by supporting others). | |
| Public attitude and preference study | • Many different methods, allowing selection tailored to particular issues (also limitation opposite).<br>• Open questions can lead to greater understanding of issues that were not targeted, as well as enable specific issues to be seen in context.<br>• Digital questionnaires can reach high numbers of people, minimise distribution costs, and be adaptive to responses.<br>• Paper questionnaires allow standard reproduction and are accessible to most people.<br>• Through answering questions, participants may understand better their personal perceptions and judgements. | • No standard method (also advantage opposite), so need to establish method tailored to each project.<br>• Public attitude and preference study is very time-consuming, whatever the individual method adopted. A lot of data are gathered, some of which may not be ultimately relevant.<br>• Need to involve high numbers of people and can be difficult to engage some. Need to be sensitive to people's time availability and different knowledge and understanding of subject matter.<br>• Computer questionnaire software can be difficult and time-consuming to master and may be limited in terms of issues that can be addressed. Requirement for a computer will also exclude some participants.<br>• Paper questionnaires are costly (financial and environmental) to produce and distribute.<br>• Need to ensure questions are not leading and that language can be understood clearly and precisely.<br>• Participants may be distracted by concerns irrelevant to research. |

The research framework shown overleaf in Figure 3.2 combined all three methods to build upon the advantages of each, and bridge or minimise the disadvantages. Within this framework, the research tended to proceed from top to bottom, left to right. This allowed the research to take advantage in the early stages of the more standardised process of LVIA, and then the findings of each stage to gradually feed the other methods and research stages in a reflexive manner.

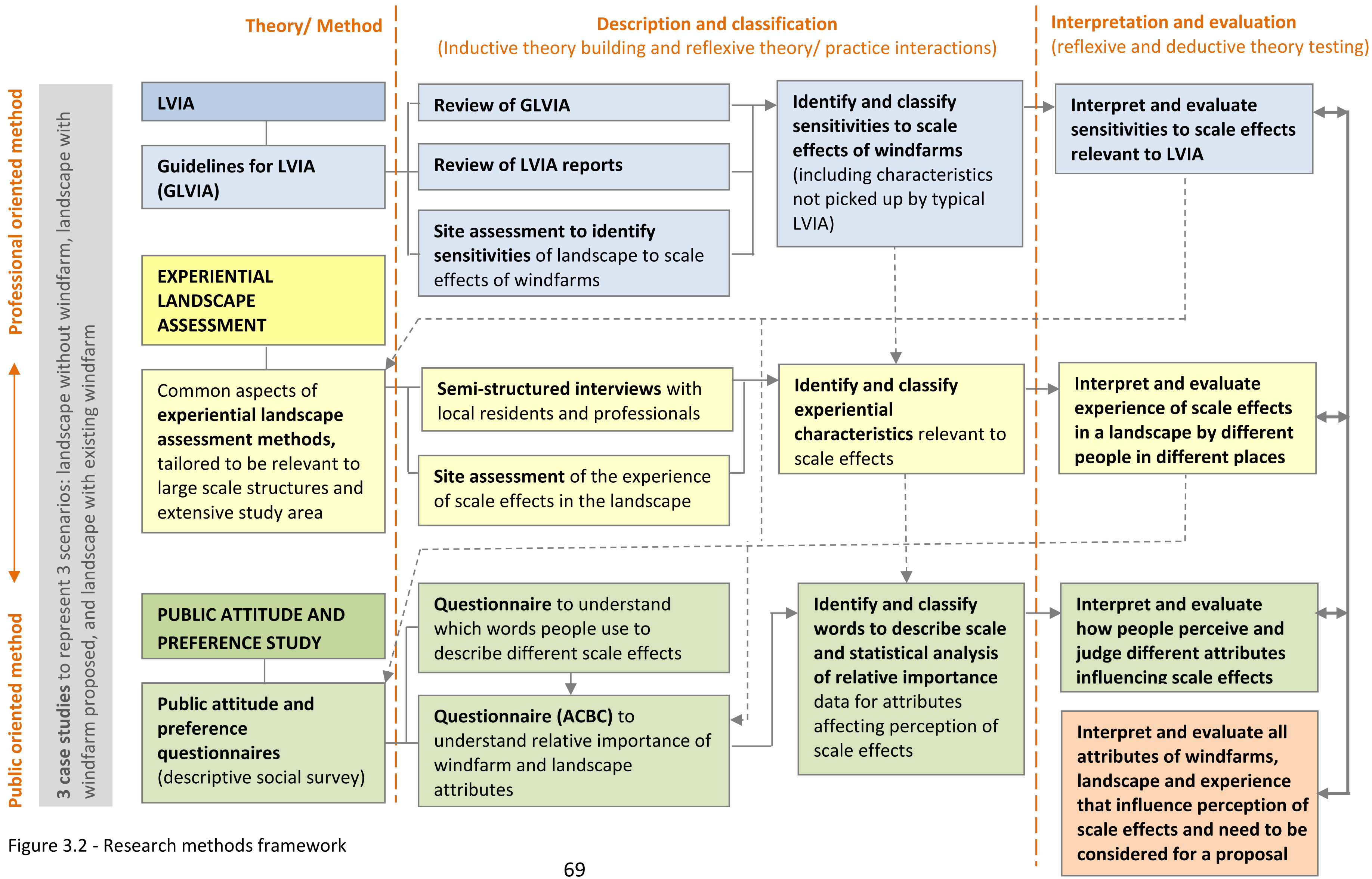



Figure 3.2 - Research methods framework

The following Table 3.2 summarises what the three methods offer in addition to the background research and literature review in terms of addressing the different research questions.

| Table 3.2: What the different methods offer to address the research questions | |
|---|---|
| *Research question* | *What is offered by the methods* |
| How do people perceive the scale effects of windfarms in a landscape? | Questions during semi-structured interviews for the **experiential landscape assessment** reveal how people perceive the scale of the landscape: what, where, how and why. For each case study, participants describe the effects of an existing or proposed windfarm, informed by visualisations and maps as appropriate. |
| | **Public attitude and preference study** identifies the relative importance of landscape and windfarm attributes to people when judging scale effect. |
| How do different scales of windfarm in different landscapes create different scale effects? | For **LVIA**, first stage assessment of a range of existing windfarms across Scotland indicates how different scales of windfarm in different landscapes result in different scale effects. Within the case studies, assessment of the range of scale effects for different existing and proposed windfarms provides more detailed findings for a similar landscape type. For some case studies, reference to visualisations informs assessment of the effects of different sized wind turbines from those existing or proposed. |
| | **Experiential landscape assessment** reveals how scale effects are influenced by the combination of different landscape characteristics and how these are experienced by different people. |
| | Through **public attitude and preference study**, different landscape and windfarm scenarios are presented and participants make choices that identify the relative importance of the different landscape and windfarm attributes to influence people's judgement of scale effect. |
| How can we site and design windfarms to minimise adverse scale effects? | For **LVIA**, first stage assessment of a range of existing windfarms across Scotland indicates how different siting and design approaches result in different scale effects in different landscapes. Within case studies, further detail is revealed through assessment of the range of scale effects for different existing and proposed windfarms within similar landscapes. Within some case studies, this assessment is informed by visualisations showing different sized wind turbines from those that exist or are proposed. |
| | The **experiential landscape assessment** reveals how key characteristics of a landscape combine, how they are experienced and why and for what they are valued, allowing identification of the sensitivities to scale effect and thus to what siting and design of windfarms needs to respond. |
| | **Public attitude and preference study** identifies the relative importance of windfarm and landscape attributes and their different types so that the relative advantages and disadvantages of different siting and design options can be judged in terms of perceived scale effect. |
| How can we best assess the scale effects of windfarms in the landscape? | Review of existing **LVIAs**, GLVIA and the scale effects of existing windfarms reveals the difference between what is typically included within a LVIA and, alternatively, what could be included within a LVIA to assess scale effects. This allows identification of potential measures to assist LVIA to assess scale effects in the future. |

| Table 3.2: What the different methods offer to address the research questions | |
|---|---|
| *Research question* | *What is offered by the methods* |
| | **The experiential landscape assessment** demonstrates what is possible when using a different approach to LVIA for assessing scale effects that includes participatory consultation with both professionals and the public, based upon the approach of focusing upon the relationship between people and the landscape (rather than a proposed development). |
| | **Public attitude and preference study** demonstrates how Conjoint Analysis can be used to understand the relative importance that people place on different windfarm and landscape attributes and, in doing so, reveal their priorities in terms of preferences (of which they may not be aware themselves). |
| | **Comparison** between the background research (including review of responses and representations to planning applications) and the findings of the LVIA, experiential landscape assessment and public attitude and preference study identifies the scope to provide useful information through different assessment methods, both individually and together. |
| How can we best communicate scale effects to different people? | Comparison between the background research (including review of responses and representations to planning applications) and existing **LVIA** reports identifies the nature of information communicated within LVIA reports from which people find it difficult to understand potential scale effects. |
| | Public consultation through **experiential landscape assessment** reveals how different people (public and professionals) describe scale effects and also different ways in which they engage in and understand others' descriptions of scale effect. Development of an interim report for the experiential landscape assessment identifies how to present information in a format that can be understood by a range of people, including both professionals and the public. |
| | A questionnaire within the **public attitude and preference study** identifies which words people use to describe different scale effects and those which are used in a more discriminating way. |
| | Through development of the **public attitude and preference study**, including the pilot study, it is possible to assess the relative benefits of different ways to describe and illustrate scale effects. |

## 3.2 Selection of case study areas

The research was carried out in three case study areas in Scotland, as listed below, to ensure that respondents represented a wide range of different opinions that might be influenced by different experiences or perceptions of scale effect.

a Dalswinton, Nithsdale, Dumfries and Galloway, representing an area with an existing windfarm;

b Druim Ba, near Abriachan, Inverness-shire, representing an area with a proposed windfarm; and

c North Mull, representing an area with neither an existing nor proposed windfarm.

The identification of these case studies followed published literature that indicated that people's opinions were influenced by having a windfarm within their local area or the perceived threat of a proposed windfarm and landscape change (for example: Coleby, Miller and Aspinall, 2009; Devine-Wright, 2005; Pasqualetti, Gipe and Righter, 2002; and Warren and Lumsden, 2008). The inclusion of case study A also allowed participants to describe how their perception of scale and experience of scale effects had changed over time between different stages: before the windfarm was proposed; during the planning process for the proposed windfarm; during construction of the windfarm; when it was first commissioned; and after many years of it being operational.

The different types of windfarm development within the three case study areas also allowed review of different LVIA information, comprising: a case study for which the LVIA information could be compared to what had been built; a case study for which a LVIA had been produced, but the development had not been built, and thus the LVIA information could be compared to people's concerns or enquiries about the scheme; and a case study for which no LVIA had been prepared, and thus a potential scheme would need to be judged in relation to strategic information (that would inform the scope of a LVIA).

The case study areas were selected following consultation with SNH, landscape architect practitioners and local authority planning officers. The four main criteria for their selection are summarised in Table 3.3 below:

Table 3.3: Criteria for selecting case studies

| Criterion | | Reason |
|---|---|---|
| a | Regional landscape character types of mixed agriculture/crofting, woodland and moorland, including characteristics relevant (sensitive) to scale effects | Landscapes include different elements and spatial characteristics that raise a wide range of issues concerning scale effects. Important to have a comparable baseline between the three different case study areas. |
| b | Area experienced from different directions, distances and in different modes of travel | To allow assessment of the different ways in which landscape and scale effects were/ would be experienced. |
| c | Landscape not designated nationally for its landscape value | To avoid perception of scale effect being influenced by expectations informed by promotion, specific planning policies, or perception of landscape or scenic value. |
| d | A local population that showed an interest in landscape effects, eg as conveyed in planning responses, in the local press or in promotion material for visitors. | To have a local population that would be willing to participate in research and convey their opinions. |

Initial feasibility study identified several candidates for case studies A and B, from which the final selection reflected the best representations of the criteria in Table 3.3. In contrast, case study C was much more difficult to identify. The starting point for exploration was undeveloped areas shown on the map of 'Windfarms in Scotland (July 2011)' produced by SNH (2011b), but this revealed few areas without proposed or existing windfarms that were not designated or for which previous exclusions could be removed soon (for example for seismic monitoring around Eskdalemuir and aviation radar in Fife). Following further consultation, it was judged that North Mull would be the best choice for case study C[80], although a mainland location would have been preferred to be more similar to case studies A and B.

The locations of the three case study areas are shown below in Figure 3.3.




Figure 3.3: Location of three case study areas

At the outset of the research, it had been expected that a standard extent of study area would be adopted for each of the case studies, similar to the standard radii usually adopted for Visual Impact Assessment (VIA)[81]. Following initial stages of the research, however, it became evident that scale effects were experienced by people over different distances in

[80] Where commercial windfarm development had not occurred, and was not expected to occur in the foreseeable future, due to inadequate electricity power-line connection.
[81] For example a radius of 35km for proposed windfarms with wind turbines 101-130m to tip (SNH, 2014b)

different landscapes and for different schemes, influenced partly by the extent and nature of visibility as well as landscape character. This meant that the extent of specific scale effects not only varied between case study areas, but extended out from individual schemes over different distances, so that the overall area of likely significant scale effects was irregular in shape. It was thus judged that the extent of the study area for each case study needed to be determined on an individual basis. Maps showing these study areas are included in Appendix C.1.

For case study C, where there was no existing or proposed development, it was not possible to determine the study area on the basis of existing or likely significant scale effects. In contrast, the study area for this case study was selected for being experienced as a distinct area (defined largely by topography, lochs and coast) and for having distinct landscape and visual characteristics and sensitivities to scale effects, as well as being of comparable size to case studies A and B.

In addition to the study area extents differing in shape and size between the case studies, the focus of attention within these varied for each of the three methods. This reflected a key criterion for assessment of scale effects for the research: that these should be significant or likely to be significant (following the criterion used for EIA (Landscape Institute and IEMA, 2013)). Of the three methods, applying this criterion resulted in the experiential landscape assessments focusing within the smallest area, whilst the LVIA extended out across most of the study area, but not continuously (for example because visibility of a scheme was screened from some locations). In contrast, participants of the public attitude and preference study were located both within and outside the geographical study area, with targeted locations for one of the questionnaires, but the other having no geographical restrictions, as explained further within chapter 4.

## 3.3 Limitations of methods and exclusions

An important part of developing the research methodology framework to address the research questions and hypotheses was to establish what was and was not possible within the scope of the research. This was influenced by the resources available and the timescale for the research, but it was also influenced by the need to limit variables so that the findings would be deliverable and clear. The following section describes some key limitations of the scope of the research and methods.

### 3.3.1 Scale effect

The focus of this research was 'scale effect' (described previously in 1.3), which is a term used to describe the perceived effect of an element as influenced by its scale in relation to the surrounding landscape and as experienced by people. This is not the same as actual size of an element in units, such as its height or distance in metres which is important to distinguish because structures of the same dimensions may have different scale effects in different contexts. Nonetheless, reference was made at times during the research to the sizes and distances of wind turbines where this was useful to understand the influence of different attributes. In addition, computer-generated wireline diagrams illustrating relative scale were based on specific sizes and distances of wind turbines, as these dimensions were required to generate the visualisations.

### 3.3.2 Wind turbine design, including form, colour and sound

Different wind turbine models are used in the UK, but most within non-domestic schemes comprise a solid cylindrical steel tower, topped by a nacelle with three wind turbine blades, and range in height from 50 – 150m to tip. For this reason, it was judged that this type of wind turbine should be taken as the standard for the research. This standardization allowed easier isolation of scale as a variable, rather than wind turbine form, although issues concerning the influence of wind turbine design were still considered when relevant.

Figure 3.4: Typical wind turbine in Scotland

Wind turbine colour was an issue that was raised repeatedly during presentations of the interim findings of this research[82] and participants often questioned whether the scale effects of wind turbines could be mitigated by the use of different coloured wind turbines.

[82] For example during presentation to the Landscape Institute North East Chapter, 17 March 2015

This seemed to be prompted by people being surprised that most wind turbines in the UK (and Europe) were white or light grey in colour when they expected that there would be scope for matching the colour of wind turbines to a land or sky backcloth.  Additionally, some people questioned whether the perceived scale of wind turbines could be diminished by using mixed colours or shades, similar to the approach used in the past for some power stations or ships (Bell, 2004; Wright, 2015).

Colour is a complex subject, especially given the large number of variations and how these relate differently to alternative landscape settings.  This meant it could not be assessed in detail by this research, but nonetheless was considered at a broad level to provide relevant context.  Reference was made to literature on the subject, particularly the most recent and comprehensive review of this topic in Scotland carried out in 2014 for SNH (LUC and Mark Turnbull Associates, 2014).  This confirms two important aspects for this research: that wind turbines in the UK are likely to continue to be off white or light grey in colour (unless small and/or consistently seen backclothed against land) and no significant scope has been identified to use wind turbine colour to reduce scale effects.

Wind turbines emit sound in two ways:  mechanical sound (commonly from the gearbox) and aerodynamic sound (from the rotation of the blades through the air, influenced by high wind speeds typically occurring on sites developed for wind energy generation) (Bolin *et al*, 2011).  The sounds of wind turbines undoubtedly affect their experience in the landscape, for example sometimes indicating their presence where they are not visible, or the increase or decrease in sound levels emphasising changes in proximity.  Nonetheless, given the complexity and specialised technical nature of the subject, the influence of windfarm noise could not be addressed within the scope of this research.

### 3.3.3 Wind turbine layout

Individual windfarms comprise wind turbines arranged in different layouts, responding to technical, social and environmental factors such as wind speed, land ownership and ground conditions.  The review of LVIA and sensitivities to scale effects for LVIA identified a number of aspects of windfarm layout that influenced perception of scale effects, such as the spacing between wind turbines affecting the scale relationship with the underlying landform and the overall extent of a single scheme (as described in chapter 5).  Nonetheless, given the high number of layout variables in relation to landscape type and the experience of these, it was not possible within the scope of this research to include detail assessment of the influence of wind turbine layout on scale effects.

### *3.3.4 Landscape type*

The early stages of this research (including LVIA stage C) involved assessment of the scale effects of windfarms across a wide range of landscape and seascape types, from the agricultural expanses of north east Aberdeenshire, to the Solway Firth and the Sutherland hills. Nonetheless, following consultation, the case study areas were selected to represent a similar combination of landscape characteristics and features in which scale effects had been identified as being important, as described previously in section 3.2. Focussing upon these landscapes that combined mixed agriculture/crofting, woodland and moorland, there was not scope to research in detail scale effects within other landscape types or seascapes, including urban areas, mountain areas and offshore.

### *3.3.5 Weather and season*

The visibility of windfarms and their perceived scale effects vary in different season and weather conditions, for example influencing movement of wind turbine blades and low cloud reducing the apparent extent of the landscape by screening distant hills. These factors needed to be considered when carrying out the research, to provide relevant context, but all the variables of weather and season could not be considered in detail. Conversely, to limit the variables of weather and season during site assessment within the different case study areas, detailed research on site was restricted to the conditions of late spring to early autumn during good visibility (rated by the Met Office as Good, Very Good or Excellent[83] (Met Office, 2015)), with sunshine and clear skies or partial cloud.

### *3.3.6 Illustrations*

Illustrations are used widely in landscape architecture as a tool to convey the sensitivity, magnitude and significance of visual effects (Landscape Institute and IEMA, 2013). Illustrations may take many different forms, including maps, photographs, sketches, and computer-generated wireline diagrams and photomontages. Furthermore, computer

[83] Defined as: good = 10-20km; very good = 20-40km; and excellent = >40km

simulations, video-montage, fly-through and wrap-around projection have become increasingly popular and available, especially with the utilisation of publically-accessible programmes such as Google Earth.

A number of research projects on the visual effects of wind turbines have used computer – generated images or simulations[84]. A benefit of using these to test people's responses to wind turbines or the landscape is that they can present a consistent image to participants (subject to variations between computer screens or printed images) and differences can be quantified, for example in numbers of pixels. Nonetheless, there are also considerable limitations to research concerning perception of landscapes and scale if based upon the use of computer generated visualisations, as discussed previously in section 1.1.1.2.

The inexact representation by illustrations of our experience of a landscape is not a new phenomenon, as discussed previously in 2.3.1. Nonetheless, perceiving specific aspects of landscape experience such as size and distance is particularly difficult when looking at two-dimensional images, and can be especially challenging when observing photographs. Given these limitations in addition to the high level of resources required to produce computer-generated visualisations, it was judged that these would be used to a minimum for this research. Additionally, whenever possible, these would only be used on site to allow direct comparison with the actual experience. Within this scope, computer generated visualisations were thus used as follows:

- When visualisations and Zone of Theoretical Visibility (ZTV) maps were included within windfarm LVIAs (produced by the developer), these were used on site to inform assessment of potential visibility and the position and relative scale of a development;
- Where computer-generated wireline diagrams could be used on site, in combination with assessment of the actual experience, to help assess and judge the different scale effects of different sized wind turbines; and
- During consultation for the experiential landscape assessment when guidance could be provided to participants on how these visualisations should be used and their limitations.

[84] For example research carried out by Bishop (2002), Bishop and Miller (2007), Lothian (2008), Sustainable Energy Ireland (2003).

Photographs were sometimes used during the research when images were required to illustrate landscape characteristics or encourage participants to describe their experience of their local area, for example during the experiential landscape assessment semi-structured interviews. Nonetheless, where scale effects needed to be illustrated during the research, it was often found that hand-drawn line drawings were most beneficial, such as the example shown in Figure 3.5 below. The use of these was influenced partly by the previous experience of the researcher in presenting line drawings to help explain landscape and visual concepts, but it also followed supportive feedback during this research from participants and consultees when line drawings were included in pilot studies and reports of interim findings.

The benefits of using hand-drawn line drawings were that they were relatively quick to produce, their diagrammatic quality provides reference to reality without providing too much detail to confuse or distract viewers, and they allow emphasis of the key characteristics of the landscape or wind turbines relevant to scale effects.

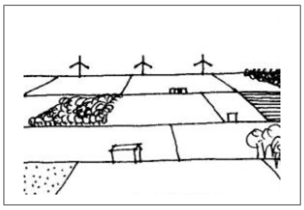


Figure 3.5: Example of hand-drawn line drawing used to illustrate scale effect

## 3.4 Consultation

Throughout the research, external consultation was carried out at a number of different stages. This was undertaken not just for the experiential landscape assessment and public attitude and preference study questionnaires, for which it was essential, but also throughout the research to provide feedback on the background to the research, methods and interim findings. For example, consultees' views were sought when exploring reasons for some of the data revealed and also how the research findings could be applied in practice and policy in the future. In addition, the interim findings of the research were presented at a number of conferences, presentations and meetings during which feedback was received.

In total, 91 people were consulted during the research (excluding those at conferences/events and participating with the public attitude and preference study questionnaires), comprising a mix of professionals, community council members and the public (further details provided in Table C.2.1 of Appendix C.2).

# Chapter 4

## INDIVIDUAL RESEARCH METHODS

This chapter describes the three individual methods of Landscape and Visual Impact Assessment (LVIA), experiential landscape assessment and public attitude and preference study following the research methodology framework outlined in chapter 3. It includes information on how each of these methods were developed and applied to address the research questions.

For each of the three methods, an important task was to identify and understand the key attributes influencing the perception of scale and scale effects in the landscape. As shown below by Figure 4.1, these have been assessed in different ways and at different stages: first, through LVIA as individual characteristics of the landscape and windfarm developments; second, through LVIA and experiential landscape assessment to understand different relationships between the attributes and how they are experienced; third, through experiential landscape assessment and public attitude and preference study to understand how the attributes are described and how different combinations are valued; and fourth and finally, through public attitude and preference study to understand how people judged the relative importance of the different attributes.

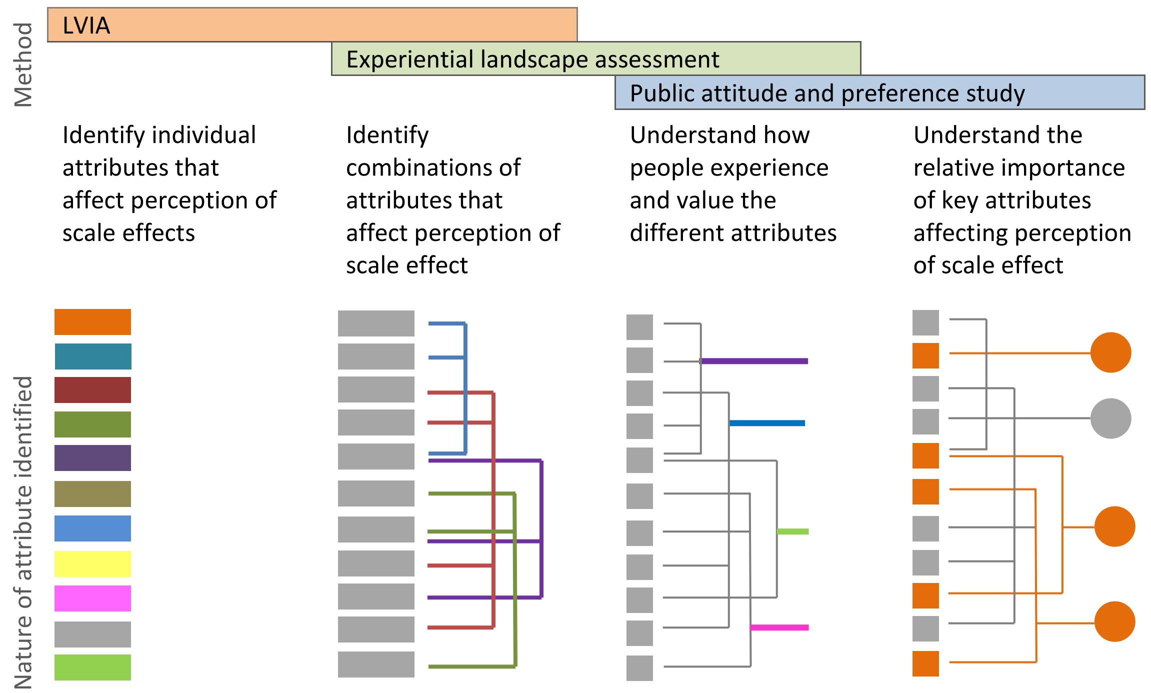



Figure 4.1: Process of identifying and assessing attributes affecting perception of scale effect

## 4.1 Landscape and Visual Impact Assessment (LVIA)

In its most basic form, LVIA follows a three-pronged approach, assessing a proposal in terms of: one, the sensitivity of the resource; two, the magnitude of the landscape and visual effects of a proposal; and three, the resulting significance of residual landscape and visual effects based on a combination of the first two factors.

For this research, LVIA techniques were analysed in four different ways to address the research questions, as summarised below in Table 4.1. It is highlighted that this did not involve carrying out a LVIA itself. Rather, the research took a critical approach to examine how the method could be used, how it was currently used in practice, and what sensitivities of scale should be considered in the future by LVIAs. This approach has been labelled 'LVIA' throughout the thesis for the sake of brevity, but should not be taken as implying that a full LVIA was carried out according to conventional practice.

Table 4.1: The different ways LVIA was reviewed or applied and the purpose of each

| *Section* | *Method* | *The contribution of the findings* | *Range of analysis* |
|---|---|---|---|
| A | Review of GLVIA with regards to scale effects (2nd and 3rd editions) | To understand how GLVIA advises scale effects should be assessed through LVIA. This is partly so this can be compared with the content of past LVIAs and public responses, to understand why gaps may occur regarding scale effects, and partly so that it is clear what scope exists in the future to use GLVIA to assess scale effects. | UK |
| B | Review of existing LVIAs for windfarms | To understand how scale effects have been assessed in the past whilst following GLVIA (2nd edition) and to identify gaps regarding the assessment of scale effects. | Scotland at 1st stage broad level, case studies at 2nd stage detail level. |
| C | Site assessment of sensitivities to scale effects of operational windfarms in UK | To identify and understand typical sensitivities to separate scale effects that needs to be considered by LVIA (if likely to result in significant effects). | UK |
| D | Assessment of the scale effects of case study windfarms | To understand in more detail the sensitivity of the landscape and visual resource of the case study areas to scale effects, including how landscape and visual characteristics are perceived and experienced in combination. This allows comparison with the effects described by the LVIAs for the case studies. | Case studies |

With regards to Task A above, it should be highlighted that the research method included assessment of GLVIA only as this was relevant to scale effects.

For case study C, as the area contained neither an existing nor proposed windfarm, no LVIA report had been produced that could be reviewed. For this reason, the capacity study for windfarms [85] that covered the area was reviewed. Although a capacity study is certainly not the same as a LVIA and follows a different process of production (SNH and The Countryside Agency, 2002c), in the absence of a LVIA, it was judged by the researcher that review of this document would be useful for at least revealing likely sensitivities of the landscape and visual resource to windfarm scale in general. In addition, whilst these sensitivities would be more strategic in nature than raised by a LVIA, they were useful to consider because they comprised information that a LVIA would draw-upon if produced within the area.

Despite the differences between the LVIAs for case studies A and B and the capacity study for case study C, for the sake of brevity, the remainder of this thesis will refer to stage B of this research method as review of existing LVIAs.

### *4.1.1 Stage A: Review of GLVIA with regards to scale effects*

This stage of the research involved review of GLVIA to identify how the guidelines recommend that scale effects should be assessed using LVIA. The second edition of the guidelines was the current edition in use at the time of the review (2010), as well as being the edition that had been used by consultants for the LVIAs for the case study windfarms, and thus it was this edition of GLVIA that was reviewed in detail. Nonetheless, analysis was also carried out subsequently of the third edition of GLVIA (Landscape Institute and IEMA, 2013) because the content of the latter is relevant to future application of the research findings (described in chapter 8).

### *4.1.2 Stage B: Review of existing LVIAs for windfarms*

Review of existing LVIAs for windfarms was carried out in two stages, as summarised overleaf in Table 4.2. The methods adopted for these two different stages reflected the

[85] Carol Anderson and Alison Grant Landscape Architects (2012a) Argyll and Bute wind energy capacity study: Main study report. Argyll and Bute Council.

reflexive nature of the research methodology framework, with the second stage building upon increased knowledge and understanding of the research questions as well as identification of the case studies.

| Table 4.2: Stages of LVIA review | | |
|---|---|---|
| *Stage* | *Scope of study* | *Source of information on which criteria based for assessing LVIAs* |
| Stage 1 | Initial stage broad-level review of five LVIAs for existing windfarms within Scotland (as listed in Table D.1.1 of Appendix D.1). | Background research and published literature, including current good practice guidance (in 2009). |
| Stage 2 | Later stage detailed review of LVIAs produced for the case studies: the existing Dalswinton windfarm in case study A, the proposed Druim Ba windfarm in case study B and the North Mull area for case study C. The sensitivities and predicted effects identified by the documents for the case studies were compared to existing or potential effects assessed on site. | Information above plus GLVIA (2nd edition), current good practice guidance (in 2012-2013), the findings of the site assessment of scale effects of a range of existing windfarms (C in Table 4.1), and preliminary assessment of the three case study areas. |

The LVIAs reviewed in stages 1 and 2 were assessed following predefined criteria (listed in Tables D.1.4 and D.1.5 of Appendix D.1). These reviews focused on scale effects only and not other landscape and visual effects. Furthermore, for the stage 2 assessment, it was predicted that not every LVIA would include description of all the criteria for assessment, as it would be expected that individual aspects would only be included if likely to result in significant effects (following the test for inclusion within EIA).

### 4.1.3 Stage C: Site assessment of sensitivities to scale effects of operational windfarms

This stage of the method involved assessment of 25 existing windfarms across the UK that demonstrated a range of scale effects. The windfarms were selected following advice by SNH and local Planning Authority advisors, as well as the prior experience of the researcher. (A list of the windfarms is included in Table D.2.1 of Appendix D.2.) The windfarms and their landscape and visual setting were assessed following a pre-defined prompt list of potentially relevant characteristics (included in Table D.2.2) identified from the background research and review of published literature.

The individual windfarms were assessed on site with the following purpose:

- To identify key sensitivities to scale effects of a range of landscape and visual receptors;
- To identify key sensitivities to scale effects influenced by windfarm siting and design; and
- To highlight key aspects of scale effect that may require further exploration through the other methods of the research.

Other assessments of the landscape and visual effects of existing structures, for example as undertaken for electricity transmission lines in England, have carried out what has been called a 'reverse LVIA' (National Grid, 2015a, 2015b; Swanwick, Gillespies and LUC, 2014), which includes assessment of the magnitude and significance of effects of existing structures. In contrast, for this and the following stage of the research method, it was felt that the priority should be to focus upon identifying the sensitivities of the landscape and visual resource to scale effects, rather than assessing in more detail the magnitude and significance of these effects[86].

Following assessment of the windfarms on site for this research stage, the data were analysed and categorised into different types of sensitivity or issue of scale. A report of the preliminary findings was prepared and distributed to a selection of consultees including landscape and planning advisors from a local Planning Authority, National Park, SNH and a windfarm developer. Some of these consultees then provided feedback and highlighted additional issues to consider.

### *4.1.4 Stage D: Assessment of the landscape and visual effects of case study windfarms*

Building upon previous broad level assessment, this stage D involved more detailed assessment of all the three case studies for the sensitivity of the landscape and visual resource to the scale effects of windfarms. This assessment included extensive site

[86] Taking a similar approach to other broad level studies such as the University of Newcastle, 2002b

assessment[87] following the same prompt list as used for Stage C (Table D.2.2 of Appendix D.2). The assessment centred upon:

| | |
|---|---|
| Case study A | Existing effects of the Dalswinton windfarm; |
| Case study B | Predicted effects of the proposed Druim Ba windfarm (application submitted); and |
| Case study C | Likely effects of a windfarm located in North Mull. |

During the site assessment process, to inform identification of sensitivities of the landscape and visual resource to different sized wind turbines, computer-generated wirelines were referenced that illustrated different wind turbine sizes (75, 100, 125 and 149.5 metres to tip) for a sample of the ES viewpoints for case studies A and B[88]. An example is shown in Figure 4.3, with a wider range included in Appendix D.12.

Interim reports were produced of the findings of this stage of LVIA assessment in combination with the findings of the experiential landscape assessment. These grouped different characteristics of the landscape and visual resource and how they were experienced alongside analysis of the effects of the existing or proposed windfarm directly upon these characteristics. An example page of one of these interim reports is shown in Figure 6.1, whilst an example complete report is included in Appendix F.1.

These interim reports were distributed to all the participants of the experiential landscape assessment within each of the case study areas, providing an opportunity for all to comment, including identifying any omissions, misrepresentations or misunderstandings. Furthermore, for the proposed Druim Ba windfarm in case study B, feedback was received from a Scottish Government Reporter (Scottish Government Directorate for Planning and Environmental Appeals, 2012) after the findings were included within evidence for a Public Local Inquiry (PLI) for the proposed windfarm. All the responses on the interim reports were reviewed and incorporated within the research findings as appropriate.

[87] On a number of different dates over different seasons.

[88] As an EIA had not been prepared for case study C, it was not possible to produce this material for this case study. The wireline diagrams for case study A were produced by Envision 3D Ltd for the Combined Community Councils as part of a submission to the Public Local Inquiry for the proposed Druim Ba windfarm. The wireline diagrams for case study B were produced by Atmos Consulting Ltd to assist the researcher (at no cost).

## 4.2 Experiential landscape assessment

Experiential landscape assessment is a method to assess the dynamic experience of the landscape and people's affordances, recognising that this embodies both perception and our personal engagement and activity within the environment (Heft, 2010; Ward Thompson, 2013). A common approach to experiential landscape assessment is described by a number of publications (Thwaites and Simkins, 2007, p40). Nonetheless, there is no single guidance document on the method similar to GLVIA, so the method for this research needed to be developed and confirmed.

From an early stage, it was predicted that there would be overlap between the experiential landscape assessment and the LVIA research methods if the latter included assessment of how the landscape and visual resource was experienced. Nonetheless, it was believed that it was of value to include both methods. This was partly because the starting points of the two are different: LVIA focusing upon a proposed development and experiential landscape assessment focusing upon the relationship between people and the landscape. Furthermore, it was important to apply an assessment approach that specifically explored people's experience of scale effects because this had been identified during the research background as being a subject people (professionals and the public) found difficult to convey. Finally, it was felt that it would be valuable to understand the similarities and differences between the findings for the two methods and how these might be used in the future in combination or to complement one another.

The method of experiential landscape assessment for this research built upon methods used previously by other studies, particularly seven that are listed overleaf in Table 4.3. These studies were reviewed for the applicability of their methods (summarised in Table D.3.1 of Appendix D.3), for example their address of issues such as: mapping techniques; notation systems; consultation and how to engage people on landscape issues; the use of focus groups, semi-structured interviews and workshops; combination of narrative text and illustrations; assessment along routes; and categorisation and coding.

| Table 4.3: Key studies upon which the experiential landscape assessment research method built | |
|---|---|
| *No* | *Author(s), date and title*[89] |
| 1 | Appleyard, D., Lynch, K. and Myer, J. (1964) *The view from the road*. |
| 2 | SNH (1994) *Seaboard local landscape study*. |
| 3 | Thwaites, K. and Simkins, I. (2007) *Experiential Landscape*. |
| 4 | University of Edinburgh (1974) *Applecross peninsula study 2.* |
| 5 | The Research Box, Land Use Consultants and Minter, R. (2009) *Experiencing Landscapes: capturing the cultural services and experiential qualities of landscape*. |
| 6 | Ward Thompson, C. (2010) Landscape quality and quality of life. In: Ward Thompson, C., Aspinall, P. & Bell, S. eds. *Innovative approaches to researching landscape and health: Open Space, People Space 2.* |
| 7 | Ward Thompson, C., Roe, J., Alves, S. (2007) *Woods in and around towns (WIAT) evaluation: baseline survey.* |

In addition to the studies listed in Table 4.3, there were a number of additional studies that provided useful information (also listed in Table D.3.1 of Appendix D.3). One of these was unfortunately published after the experiential landscape assessment for this research had been completed: 'People, place and community: the missing chapter' (Haggett, Coleman and Hodges, 2015). Nonetheless, review of this study and interviews with two of the authors was carried out to inform the later stages of this research when exploring potential methods of assessment for the future and application of the findings of this research in practice (described in chapter 8).

Through further development of the experiential landscape assessment method for this research, a number of key challenges were encountered, as listed below.

- A need to consider a wide range of experiences across large study areas. This included linear sequences along individual routes similar to the 'view from the road' studies, but also a network of routes and using different modes of travel, for example car, walking, cycling or horse-riding. In addition, there was a need to consider the landscape experience from individual places and areas, which may also be of very different character and visited for different reasons, for example home, work, meeting place, recreation.
- A need to focus upon aspects of the landscape relevant to the experience of landscape scale and scale effects, whilst also being able to understand how these

[89] Full references included in the thesis references and in Appendix D.3

relate to the wider context of the landscape and how this is experienced and valued by different people.

- A need to involve professionals and members of the public within consultation, so that the experiences and judgements of both could be understood.
- A need to structure and present information that could be understood easily by a wide range of participants (both professionals and members of the public) and a need to communicate clearly issues of scale sensitivity and effect, which tend to be difficult to describe and illustrate.
- A need to develop a method that could be applied consistently within different communities (as represented by the different case studies).

The experiential landscape assessment for this research was carried out in three different stages in addition to background research: A, site assessment; B, semi-structured interviews and consultation; and C, data analysis and interpretation. These are described within the following section.

### 4.2.1 Stage A: Site assessment

This stage of the research involved site assessment of the case study areas, analysing them for key attributes relevant to the experience of landscape scale and scale effects. The criteria for assessment were grouped into four categories as shown below in Figure 4.2 (listed in further detail within Table D.4.1 of Appendix D.4). The site assessment was carried out in two stages: first, before the consultation stage to inform discussion during the semi-structured interviews; and second, after the consultation stage to be able to examine further aspects raised by participants during the semi-structured interviews.

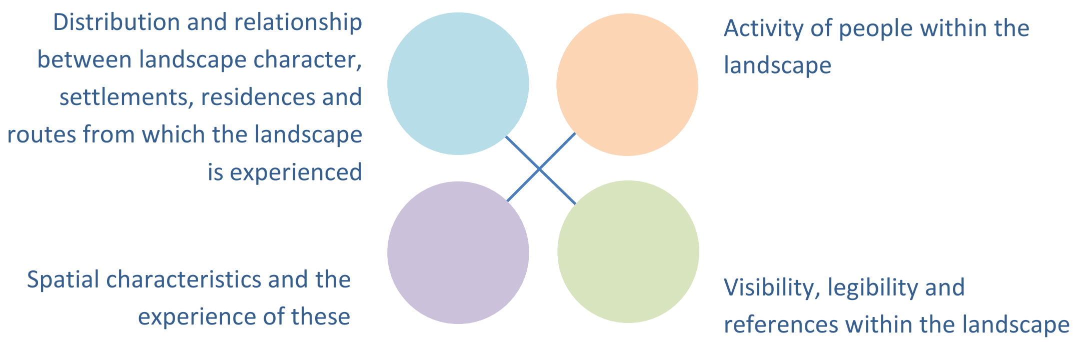



Figure 4.2: Categories of attributes assessed by the experiential landscape site assessment

### 4.2.2 Stage B: Semi-structured interviews

Consultation with people in all three of the case study areas was carried out through a series of semi-structured interviews: some with individuals and some with groups of people. Participants included representatives of local planning authorities, SNH and Community Councils, as well as individual members of the public and professionals living and working in the case study areas.

To select participants, the researcher first contacted the local Planning Authority, SNH and all the Community Councils that occurred within all the case study areas and semi-structured interviews were arranged with representatives from all these organisations. In addition, the representatives of these organisations were asked to identify additional groups, residents or professionals within all three of the case study areas which they thought would have information relevant to the research. This led to additional semi-structured interviews being organised with, for example, representatives of a forest trust that organised school visits to the area, local residents that were involved in landscape projects, a local artist, a local architect, and representatives of a windfarm opposition group. The numbers and types of these participants are shown in Appendix C.2.

The semi-structured interviews were carried out in various locations at the convenience of participants, including village halls, local cafés and people's homes. In addition, for each case study, a group semi-structured interview was arranged on site that involved visiting a selection of representative viewpoints[90]. These site meetings were very useful, particularly with regards to understanding the cues people used to perceive scale in the landscape, which were often clearer to people on site than from memory. Nonetheless, organisation of these meetings on site was very challenging. This was due to the need to transport many participants and the need for good weather (for participants' comfort) and visibility conditions (to see the views) which could only be confirmed at short notice. In addition, many community representatives were only available during the evening which restricted assessment to the summer months when it was light.

[90] ES viewpoints for case studies A and B

During semi-structured interviews inside, a table was arranged centrally between the participants on which maps were placed, as it was found during the pilot study that this 'round table' format facilitated discussion and the engagement of all the attendees. The workshops varied in their number of participants, but were limited to a maximum of six people (excluding the researcher), as it was found during the pilot studies that this number allowed the interviews to be most effective and manageable.

A key challenge during the semi-structured interviews was to ensure that participants were not unduly led in their responses. To assist, the focus of the questions was placed initially on establishing people's perception and judgement of the key characteristics, qualities and experience of the landscape and visual resource 'windfarm aside'. Only after this baseline had been established, was the landscape experience and effects of existing or proposed windfarms discussed.

During the interviews, the questions were put at first to each of the attendees one-by-one around the table. This was principally to ensure that all participants were involved and engaged with the process although, through the pilot exercise, it was found that this also reduced the need for the researcher to interject. This was because, once the participants realised that everyone was expected to contribute, they often prompted each other and/or expressed their opinion through agreeing with others or building-upon previous responses.

All of the participants of the semi-structured interviews were highly familiar with the case study landscape. Nonetheless, a number of colour photographs at A3 size were made available upon the central table. These acted as an *aide memoir* for participants and were also found to help some explain scale issues, ie by pointing at an example whilst describing characteristics rather than having to rely on words alone.

For one of the questions[91] in the semi-structured interviews for case studies A and B, some computer-generated wireline diagrams were available as a tool to inform the influence of wind turbine size on scale effect[92]. These wirelines were compared to the ES photographs or to the real view on site and showed the effects of the existing or proposed wind

[91] Question F, shown in Table D.4.2 of Appendix D.4
[92] These were the same wireline diagrams as used previously for the LVIA method.

turbines[93] in comparison with other sizes of wind turbines at 75m, 100m, 125m and 150m to tip. An example of one of these wireline diagrams is shown overleaf in Figure 4.3, with further examples of a complete range included in Appendix D.12.

[93] In comparison, the case study A existing wind turbines are 125m to tip and the case study B proposed wind turbines were 149.5m to tip.

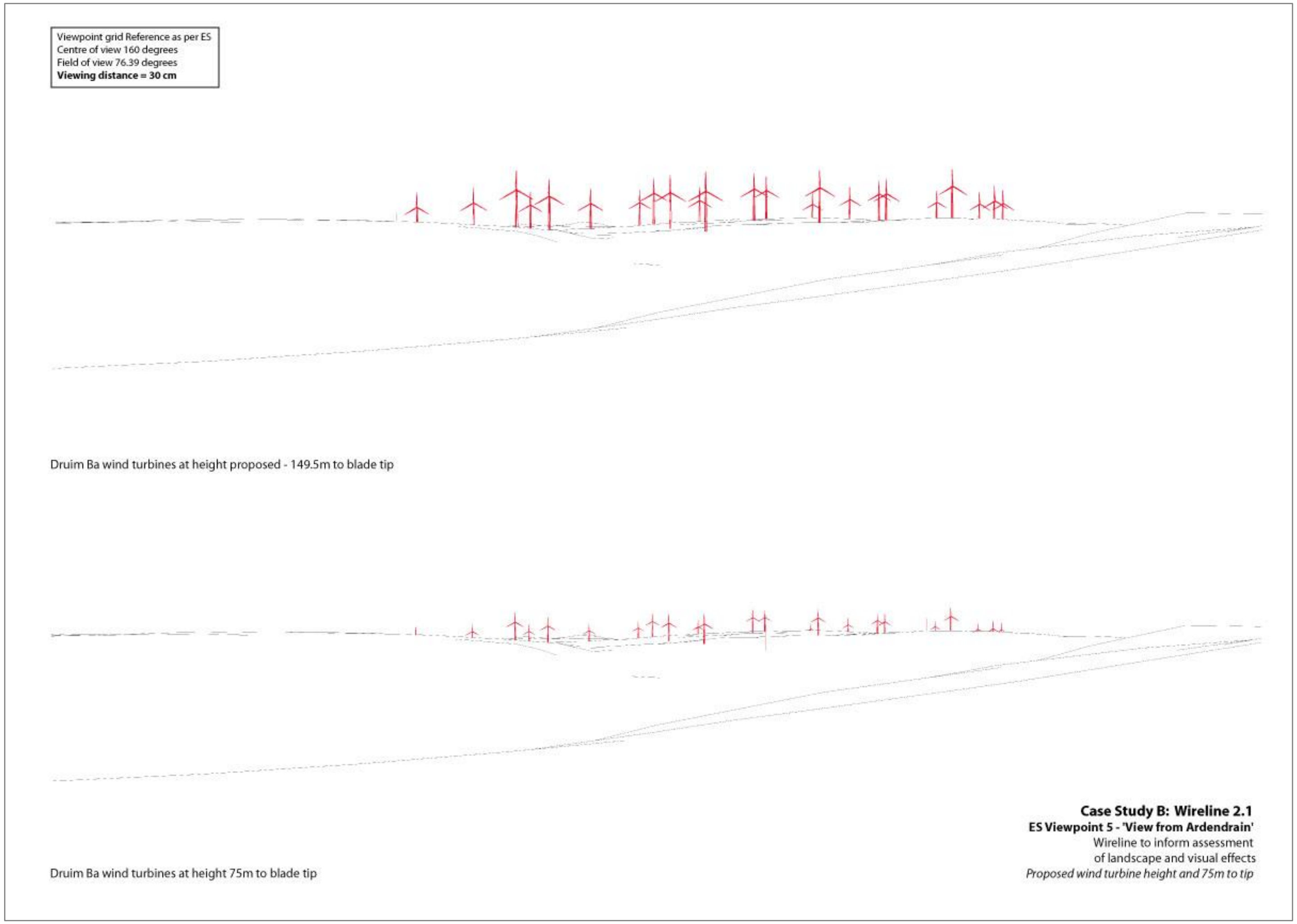



Figure 4.3: Example of wireline diagrams produced to inform assessment of potential differences of scale effect resulting from different sized wind turbines (not to scale, original at A3 included in Appendix D.12)

The questions for the semi-structured interviews covered the following topics (described in further detail within Table D.4.2 of Appendix D.4:

a The key characteristics and qualities of the landscape;

b Where and when people go to experience these characteristics and qualities;

c Who experiences the characteristics and qualities and why;

d The changes that have occurred in the landscape and are likely to occur in the future;

e The elements or features of the landscape which people use as cues to perceive distance or scale when looking at a view;

f How the existing or proposed windfarm affects the key characteristics or qualities of the landscape, how it affects the experience of this and/or the behaviour or activities of people, and how this would have been different with other scales of windfarm (informed by visualisations). In addition, for case study A, how these effects have changed over time.

Through the pilot study, it was found to be preferable to limit direct questions as much as possible in addition to a-f above, in favour of letting people reveal information gradually and then filtering this to extract relevant data (supporting Thwaites and Simkins, 2007). In this way, the relative importance of various issues could be appreciated in context.

The discussion and answers to questions at each of the interviews was recorded in writing by the researcher. Although voice recording had been considered, it was found through pilot study that people seemed freer in their expression and language if they were not being recorded audibly. In addition, feedback from a pilot interview was that the action of the researcher looking away to write notes reduced perceived pressure on participants for continuous dialogue and also reassured them about the relevance and importance of the information they were providing as they spoke.

The process of writing notes of the discussion provided the opportunity to apply an initial sieve for relevant data. Nonetheless, it was also important to record how different people described in their own words some of the characteristics of landscapes and their experience of these in order to understand better the language different people used to express particular aspects.

Following the methods of other experiential landscape assessment studies, it had been planned originally that participants of the semi-structured interviews would be asked to identify and mark landscape characteristics, qualities or scale effects upon map overlays or, alternatively, the researcher would mark these in response to participants' comments. During the pilot exercise, however, it became apparent that a high proportion of the public participants (unlike the professionals) found this direct geographical notation a bit uncomfortable, as if they were being 'put on the spot'. Alternatively, most seemed more at ease and willing to describe and share information verbally (written down by the researcher), whilst pointing at different areas on maps (or features within photographs if preferred).

On reflection, one of the reasons why some public participants may have resisted direct annotation of maps may have been the difficulty of conveying scale issues compared to other landscape and visual issues, for example bridging the gap between recalling visual or spatial experiences and transferring these onto a two-dimensional map. In addition, it may have been hard for them to represent graphically places, characteristics and experiences that were widely disparate in scales, yet overlapped. For example, it is difficult to represent the local sense of enclosure within a glen and the intricacy of vegetation, whilst also representing the wider sense of openness and panoramic views over the glen from surrounding hills. This was supported by the fact that many participants flipped between the broad level 1:50,000 OS maps and the more detailed 1:25,000 OS maps that were available, effectively 'zooming' in and out to make it easier to refer to specific issues.

### *4.2.3 Stage C: Data analysis and interpretation*

The first stage of data analysis from the experiential landscape assessment involved reviewing all the data gathered during the site assessment and consultation events, including written notes, maps, photographs and sketches, and categorising these into different landscape characteristics, combinations of these, and ways in which the landscape was experienced.

Although the focus of the experiential landscape assessment was the perception, experience and effects of scale, data on other landscape and visual aspects were also collected whilst carrying out this method. This was for two main reasons: one, so that sensitivity to scale and scale effects could be understood within the context of the wider landscape experience; and two, because it was judged that participants might engage better with consultation if this referred to the wide composition of characteristics and experiences within their landscape, rather than just scale issues (informed by The Research Box, LUC and Minter, 2009).

The interim findings of the experiential landscape assessment for each case study area, which built upon the findings of the LVIA, were drawn-up within a table that had two columns running side-by-side, as shown in Figure 6.1. The left hand column described the key characteristics of the landscape and how these were experienced, whilst the right hand column described the corresponding effects of the existing or proposed windfarm upon these characteristics and experiences. The information was also grouped according to different combinations of characteristics and experiences. A report of these interim findings within each of the separate case study areas was sent to all the individuals and representatives of groups that had participated in the experiential landscape assessment consultation. This was accompanied by a cover note asking participants for any comments or to highlight any misunderstandings, omissions or misrepresentations.

Following subsequent incorporation of feedback from participants, the findings of the research were analysed further to focus upon those aspects most important to the perception and experience of scale in the landscape. These were grouped under the four categories shown previously in Figure 4.2.

## 4.3 Public attitude and preference study

Public attitude and preference studies vary in their methods, but possess a common aim to understand better people's opinions or judgements of certain issues. For this research, the public attitude and preference study included two different questionnaires: one to examine the words people use to describe scale effects; and the other to apply Adaptive Choice-Based Conjoint (ACBC) analysis to understand the relative importance that people place on different attributes influencing perceived scale effect. The methods for these questionnaires are described within the following section.

### *4.3.1 Questionnaire to reveal the words people use to describe scale effects*

At the outset of this research, it had not been expected that a questionnaire would be required to identify the words people use to describe scale effects. During the literature review and early stages of the research, however, it became increasingly apparent that different people might be using the same words to describe different scale effects and/or using different words to describe the same scale effects. The aim of this questionnaire was thus to ascertain which words were used most frequently and consistently to represent specific scale effects. This would allow these to be subsequently adopted for the remaining stages of the research and during consultation. A number of methods for the questionnaire were explored and a pilot exercise was carried out (summarised in Appendix D.5).

#### 4.3.1.1 Composition of the questionnaire

The questionnaire included 2 pages of introduction and explanation at the beginning, followed by nine pages showing nine different photographs of windfarms with different scale effects. An example page is shown overleaf in Figure 4.4, whilst a copy of the full questionnaire is included in Appendix D.7 (on DVD).

Selection of the windfarms to illustrate the scale effects was based upon the early findings of the LVIA method, including consultation with a range of planners and landscape architects. The scale effects represented by the photographs were chosen by the researcher for falling into low, medium or high scale effect categories, although this was not indicated within the questionnaire so the focus of the participant was on selecting a word that matched the effect, not a particular category.

3

Please circle one or more words within the table below which you think describe the scale effect of these wind turbines within their surroundings. Then, for any word you have circled, please rate the level of that effect from 1 (weak) to 5 (strong).

If you think of another word that better describes the scale effect, please add this to the bottom of the table and rate its level.

| *Words to describe effect* | weak effect | ← | → | | strong effect |
|---|---|---|---|---|---|
| Unassuming | 1 | 2 | 3 | 4 | 5 |
| Fitting | 1 | 2 | 3 | 4 | 5 |
| Balanced | 1 | 2 | 3 | 4 | 5 |
| Dominating | 1 | 2 | 3 | 4 | 5 |
| Influential | 1 | 2 | 3 | 4 | 5 |
| Imposing | 1 | 2 | 3 | 4 | 5 |
| Modest | 1 | 2 | 3 | 4 | 5 |
| Overbearing | 1 | 2 | 3 | 4 | 5 |
| Unobtrusive | 1 | 2 | 3 | 4 | 5 |
| *Your term:* | 1 | 2 | 3 | 4 | 5 |

Any other comment you wish to make:

______________________________________________

______________________________________________

5

Figure 4.4: Example page showing format of questionnaire to examine use of words to describe different scale effects (see Appendix D.7 on DVD for complete questionnaire)

There are limitations to how photographs can represent scale effects (as discussed previously in section 2.3.1). Nonetheless, for the specific purposes of this study, it was judged that an impression of broad effect could be conveyed sufficiently through the use of three photographs for each level of scale effect. Furthermore, variation in the representation of the images was limited by distributing paper copies of the questionnaire, rather than these being viewed on different computer screens that could vary in representation, for example in size, resolution and colour.

The order of the photographs within each questionnaire was the same for each participant, but the three levels of scale effect represented by the photographs were mixed to try to avoid conditioning responses, for example showing images for a low scale effect, followed by a high scale effect, then medium etc. Furthermore, it was hoped this would encourage the participant to focus upon matching the words to the specific individual image, rather than thinking about the relative differences between the scale effects shown.

The words to describe scale effect included within the questionnaire were taken from the review of planning responses during the background research stage as well as during consultation for the LVIA and experiential landscape assessment methods. During the initial review of these words, it was found that there were many more words used for a high effect, than a medium or low effect, meaning there were more words to choose from to describe high effects in comparison to medium or low effects. In addition, there were more words used interchangeably for high scale effect, such as 'overwhelming' and 'overbearing'.

The final selection of words for the questionnaire was based on frequency of use within consultation and planning responses, the need to select words that represented clearly different effects, and a need to avoid terms that were often used to describe visibility or prominence (such as 'noticeable' or 'conspicuous') that did not specifically represent scale effects. The final selection was also informed by feedback from the pilot study and is listed below.

- High effect: overbearing; dominating; imposing.
- Medium effect: balanced; modest; influential.
- Low effect: unassuming; fitting; unobtrusive.

These words were mixed together within the response box on the questionnaire pages (as shown overleaf in Figure 4.5). This was partly to minimise bias, but also because it was realised that some terms represented slightly different scale relationships, for example 'fitting' suggested a scale relationship with the receiving environment, whilst 'overbearing' suggested a scale relationship with an observer. In addition to the range of words offered by the questionnaire, participants were advised that they could use their own word if they preferred and to add this to the selection table. They were also encouraged to add any comments that they had on the use of these words or issues of scale effect raised by the questionnaire.

Originally, it was thought that just one word would be required to be selected for each scale effect, but the pilot study revealed that some participants preferred to identify two or three words for each effect. Although this resulted in a greater number of words selected, and thus broader preferences indicated, it was judged that it was better to allow this than misrepresenting a wider range of words that respondents would use in practice.

Within the questionnaire, respondents were asked to: '…*circle the word or words which you think describe best the scale effect of the wind turbines within their surroundings'*. For each of these terms, a Likert scale was included and thus they were advised: *'Then, for any word you have circled, please rate the level of effect from 1 (weak) to 5 (strong)…'* It was stressed that: *'there is no right or wrong answer – it is just your opinion that is wanted'*. To assist participants, an example response table was shown, as per Figure 4.5.

| *Words to describe effect* | *weak effect* | ◄ | | ► | *Strong effect* |
|---|---|---|---|---|---|
| **Unassuming** | 1 | 2 | 3 | 4 | 5 |
| **Fitting** | 1 | 2 | 3 | 4 | 5 |
| **Balanced** | 1 | 2 | 3 | 4 | 5 |
| **Dominating** | 1 | 2 | 3 | 4 | 5 |
| **Influential** | 1 | 2 | 3 | 4 | 5 |
| **Imposing** | 1 | 2 | 3 | 4 | 5 |
| **Modest** | 1 | 2 | 3 | 4 | 5 |
| **Overbearing** | 1 | 2 | 3 | 4 | 5 |
| **Unobtrusive** | 1 | 2 | 3 | 4 | 5 |
| *Your term:* *comparable* | 1 | 2 | 3 | 4 | 5 |

Figure 4.5: Example response box given in the questionnaire to examine use of words to describe different scale effects

In addition to questions concerning scale effect, a number of questions were included at the end of the questionnaire to identify the demographic characteristics of the respondents. These concerned respondents' age, location, occupation, attitudes to windfarms and the number of windfarms they had seen previously. These specific characteristics were included because they had been raised in published literature as having the potential to influence people's responses to windfarms (described previously in 2.7). The response choices are listed within Table D.6.1 of Appendix D.6.

#### 4.3.1.2 Distribution of the questionnaire

The questionnaire was distributed to a range of recipients within each of the three case study areas. These included samples across four main types of people following identification within published literature that attitudes may vary between these. They are as follows:

- Members of the public in rural residences from which a windfarm would be likely/ is seen;
- Members of the public in rural residences from which a windfarm would not be likely/ is not seen;
- Members of the public in urban residences of a nearby city or town from which a development would not be likely/ is not seen; and
- Professionals whose work includes consideration of windfarms within the case study area.

Unfortunately, there were some groups of people that could not be included as they did not exist within the three case study areas, for example members of the public in urban residences of a nearby city or town from which a windfarm would be likely/is seen.

The questionnaire was sent by post to the professionals. For all other participants, it was delivered by hand to allow the researcher to confirm on site, prior to delivery, the type of visibility conditions. This ensured equal numbers of recipients with or without visibility of an existing or potential windfarm[94]. For these locations, the questionnaires were distributed to a sample of residences following advice from the local council on achieving an even representation of socio-economic characteristics. Included with each questionnaire was a stamped, addressed envelope for return of the completed questionnaire.

#### 4.3.1.3 Data analysis

Once the completed questionnaires were received by post, the written responses to each question were transferred to an Excel database and then imported into SPSS. Originally, the data were analysed to explore the relationships between different words selected by different individuals and those within different case study areas, as well as the different words selected by those with different demographic characteristics (including the use of non-parametric tests for correlation and factor analysis). Whilst this proved an interesting

[94] This information could not be gained from existing data sources or Zone of Theoretical Visibility (ZTV) maps because these do not represent local features such as trees and buildings that can screen views of a windfarm from a residence

process (and would be a useful subject for future research), it became increasingly clear through concurrent progress on the other research methods that the key priority for the data analysis was to understand better which words were used most commonly and in the most discriminating way by the total range of people. Thus, following re-focus of the data analysis process, the main method applied was counts analysis to answer the following questions:

- Which words are chosen most commonly to describe scale effect in general?
- Which words are chosen most commonly to represent high, medium or low scale effects?
- Which words are chosen in the most discriminating way to represent high, medium or low scale effects?

### *4.3.2 Adaptive Choice-Based Conjoint (ACBC) analysis to reveal the relative importance of different attributes to influence scale effects*

Conjoint Analysis was the second method of the public attitude and preference study and the final method undertaken for the research, allowing it to build upon the findings of all the previous methods. Its main purpose was to reveal the relative importance of attributes[95] when judging scale effect, calculated by asking people to make preference choices based on trade-offs. The software for this study was provided by Sawtooth Software Inc on an academic grant[96].

Conjoint Analysis is a statistical technique used commonly in marketing to determine how people value different attributes or variations of these called 'levels' that make up an individual product or service. It requires participants to make a series of trade-offs and, from analysing these, the relative 'importances'[97] that they place upon the different attributes and levels[98] can be revealed. For example, people might be questioned about three attributes of a restaurant that would influence their preference: size, location and cost of dishes. For these attributes, the separate levels might be: a large, medium or small

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[95] From a focused range, as shown in Figure 4.1.

[96] Software Software SSI Web (version 8.2.4) was provided for the purposes of academic study. More details are available at: http://www.sawtoothsoftware.com/academics/grants

[97] These are defined by Orme (2010, pp170-171) as 'the maximum impact an attribute can exert upon product choice'. Attribute importance is calculated by finding the percentage of the range in utilities across attributes. It is a relative measure in relation to the attribute levels involved.

[98] Which may be nominal, ordinal or ratio variables

restaurant for size; city centre, rural or waterfront for location; and cheap, mid-range or expensive for cost. Through making a series of choices between various combinations, for example a small size, waterfront, expensive restaurant compared to a medium size, waterfront, cheap restaurant, it can be ultimately revealed what is most important to respondents when making the choice of where to eat. This choice may be different to what they would have identified if asked directly.

Although Conjoint Analysis is not used frequently in landscape architecture, it has been applied to a number of research studies in the past to explore preferences such as house type (Aspinall, 2010a), outdoor spaces (Laing *et al*, 2009) and the environmental or economic costs of windfarms (Álvarez-Farizo and Hanley, 2002). It is particularly valued for being a ‘top down’ method, which allows it to predict better people’s behaviour and choices in real life than other methods of preference study that, instead, consider each attribute in isolation from the ‘bottom-up’. Specifically for this research, Conjoint Analysis was selected for being able to present engaging and realistic scenarios of landscape scale effect (that can otherwise be difficult to convey), whilst also forcing people to reveal their priorities in terms of preferences by asking them to make trade-offs, avoiding the common response that ‘they are all important’ or ‘it all depends…’.

Understanding better people’s priorities for preference is particularly important with regards to perceived scale effect because many people think they consider scale ‘automatically’. As a consequence, earlier stages of the research had found that, although most people thought perception of scale effects was very important, they did not necessarily recognise what influenced most strongly the judgements they made. This limited the scope to understand better people’s perceptions of scale through other methods of survey including asking them direct questions.

Selection of the type of Conjoint Analysis and Sawtooth Software was informed by reviewing published literature (for example: Aspinall, 2010a; and Orme, 2009 and 2010) as well as some useful technical papers, sample questionnaires, demonstration surveys and an ‘interactive advisor’ available upon the Sawtooth Software website[99].

[99] Available at: http://www.sawtoothsoftware.com, including the interactive advisor (Sawtooth Software, n.d.4)

#### 4.3.2.1 Identification of attributes to take into the ACBC

Eighty six individual and composite attributes affecting the perception of scale effect were identified during the LVIA and experiential landscape assessment methods of research (as represented previously by Figure 4.1). Consequently, it was not possible to take all of these into the ACBC and it was necessary to carry out a detailed review of these to identify the attributes and levels that were important to the research questions, yet their relative importance had not been able to be confirmed by the other methods of the research.

Orme (2010, p51-52) states '*defining proper attributes and levels is arguably the most fundamental and critical aspect of designing a good conjoint study*'. Informing this process, Sawtooth Software (2013a, pp359-360) advises the following:

a Attributes should be independent;

b Levels within each attribute should be mutually exclusive;

c Attribute levels should cover the full range of possibilities for existing situations as well as those that have not been encountered, but may exist;

d Prohibitions[100] should be avoided if possible;

e The number of levels chosen to define an attribute should be considered carefully as this can have a significant bearing on results; and

f Attributes that cannot be adequately described in words should be represented in multimedia.

In addition, the following criteria were identified as being important to the choice of attributes and levels for this research:

g That the attributes needed to affect perception of scale effect by a *significant* degree (although all the attributes identified were important*)*;

h That attributes and levels could be excluded if their relative importance to people had already been identified through the other research methods of LVIA and

[100] Also known as restrictions. These are applied where combinations of different attribute level need to be avoided as they do not represent a realistic scenario; for example a busy street attribute level and a sense of tranquillity attribute level. For more information, refer to Appendix D.9.

experiential landscape assessment (as the findings of all three methods would be considered in combination);

i That the attributes must be able to be distinguished and explained clearly, so they could be judged independently[101] and, if not able to be distinguished individually, could be represented within an attribute level;

j That combination of the attributes or attribute levels needed to represent realistic scenarios for experiencing scale effects in Scotland.

A summary of the detailed review carried out for all the attributes and the final selection of those for the ACBC is provided within Table D.8.1 of Appendix D.8.

Sawtooth Software recommends that ACBC studies test no more than 12 attributes over up to seven levels (2013a, p 453). Furthermore, a balance has to be struck between selecting sufficient attributes and levels to address the research questions, but not so many that the questionnaire becomes too complex and/or lengthy that people do not complete it well or in sufficient numbers to provide useful and robust data.

The final attributes taken forward into the ACBC study are listed in Table 4.4 overleaf.

[101] This includes consideration of whether the attributes could be represented clearly following the format of the questionnaire

| Table 4.4: Attributes and levels included within the ACBC | | |
|---|---|---|
| *Attribute for ACBC* | | *Levels* |
| 1 | Context of experience | Seen from a garden |
| | | Seen while driving a car |
| | | Seen while on a local, lowland walk |
| | | Seen from a local hill-top |
| | | Seen from the window of a sitting room within a house |
| 2 | Landscape type | Seen in an agricultural and settled landscape |
| | | Seen in a moorland landscape |
| | | Seen in a wooded landscape |
| | | Seen upon the backcloth hills above a mixed landscape pattern |
| 3 | Size of wind turbines | Small size |
| | | Medium size |
| | | Large size |
| 4 | Proximity of windfarm | Nearby |
| | | Middle distance |
| | | Far distance |
| 5 | Windfarm size (reflecting number of wind turbines) | Single wind turbine |
| | | Small cluster of wind turbines |
| | | Medium number of wind turbines |
| | | Large number of wind turbines |

Some attributes that did not meet the criteria for being included within the ACBC study were still able to be included within the questionnaire as non-conjoint questions (named by the software as 'select' questions). The attributes included in this manner are listed in Table 4.5 overleaf (with further detail explaining the rationale for their inclusion in Table D.8.1 of Appendix D.8).

| Table 4.5: Attributes to be included within the non-conjoint part of the questionnaire | | |
|---|---|---|
| *Attribute for non ACBC part of questionnaire* | | *Levels* |
| i | Cumulative distribution of windfarms | More than one windfarm visible in different directions of view |
| | | More than one windfarm visible in same direction of view |
| ii | Proportion of wind turbines | Wind turbine blades short in relation to tower height |
| | | Wind turbine blades about half tower height |
| | | Wind turbine blades long in relation to tower height |
| iii | Cumulative extent of windfarms relative to open space | Minor proportion of windfarms to open space |
| | | Between minor and similar proportion of windfarms to open space |
| | | Similar proportion of windfarms to open space |
| | | Between similar and major proportion of windfarms to open space |
| | | Major proportion of windfarms to open space |
| iv | Viewer elevation and position relative to windfarm | From nearby, looking upslope towards windfarm |
| | | From a distance, below the level of the windfarm |
| | | From distant hill slopes, at similar level to the windfarm |
| | | From distant hill slopes, at a higher level than the windfarm |

#### 4.3.2.2 Composition of the ACBC questionnaire

The ACBC questionnaire was constructed using guidance provided by Sawtooth Software (2013a), but tailored to address the specific research questions. Appendix D.9 includes a detailed description of how the questionnaire was developed and the rationale for the final content and format of the questionnaire. This includes a summary of three pilot studies.

For this research, development of the ACBC questionnaire included considerable exploration of the use of images within the questionnaire. This was mainly because of the need to convey characteristics of landscape experience and scale effects in a way that could be understood clearly. It was eventually decided that black and white hand-drawn line drawings should be included within the questionnaire (as described in detail in Appendix D.9) to represent two of the attributes: landscape type and the context of the experience, as shown in the examples overleaf in Figure 4.6. These were included principally to help the questionnaire participant 'place themselves' within the landscape scenario being presented, but not distract them with irrelevant detail that might be included within an equivalent photograph.

Figure 4.6: Examples of hand-drawn black and white drawings included within the ACBC questionnaire to illustrate different combinations of landscape type and context of experience

Following exploration and pilot study, it was decided that, unlike the landscape type and context of experience attributes, the different windfarm attributes should not be illustrated within the ACBC drawings. This followed feedback from participants of a pilot study who reported that including these tended to lead them to make judgements based on the qualities of the complete visual composition viewed (in a detached way, like viewing a picture on a wall), rather than using the images as a tool to help them predict what it would be like to be in a location and experiencing different scale effects.

In addition to questions concerning scale effect, a number of questions were included at the end of the questionnaire to identify the demographic characteristics of the respondents. These were the same as those used for the previous questionnaire to understand the words people used to describe scale effects (described previously in section 4.3.1) and concerned respondents' age, location, occupation, attitudes and the number of windfarms they had seen previously. The response choices for these questions are listed within Table D.6.1 of Appendix D.6.

A copy of the final questionnaire can be seen by clicking the following link: https://www.survey.eca.ed.ac.uk/scaleperception/login.html [102]. A pdf copy of the questionnaire is also included within Appendix D.10, but limitations of the PDF file type mean that this copy is slightly different in format, includes code markings and is not 'adaptive', thus showing more options than would have actually been presented together. In addition, a copy of the supplementary guidance notes which were available to participants of the questionnaire is included in Appendix D.11. These notes offered further

[102] To record progress, the questionnaire uses cookies and, after completion of the questionnaire once, subsequent attempts to access this on the same computer are blocked. Nonetheless, if an examiner wishes to view the questionnaire more than once on the same computer, this is possible by deleting temporary internet files.

information on the method, attributes and terminology of the questionnaire (including definition of the words for the attribute levels such as ‘small’ or ‘large’) and were accessible via a link on all relevant pages. These notes also addressed issues raised during the pilot studies. The content of the questionnaire is summarised in the following Table 4.6.

| Table 4.6: Summary of the contents of the ACBC questionnaire | |
|---|---|
| Introduction | Six pages described the background to the study. This included: why it was being carried out; how long it would take to complete; how the findings would be used; an introduction to the method of Conjoint Analysis; key terms used within the questionnaire; and how to obtain additional information. |
| ACBC: Build Your Own (BYO) | Build Your Own (BYO) is included in ACBC for respondents to indicate their preferences for individual levels before these are presented within the ‘choice tournament’. These selections help inform the ACBC software about which attribute levels might be most useful to present to participants in the choice-based questions. The first page of the BYO asked participants to select the landscape type and context of experience attribute levels they thought would make a windfarm appear most overbearing, revealing a combined image of this in response to the selections made. The second page introduced the remaining attributes that were not included in the BYO: size of wind turbines; proximity of windfarm; and windfarm size. |
| ACBC: Screening questions | Six pages showed three concepts on each page that combined different levels of the five attributes. Participants needed to choose whether the resulting windfarm was ‘likely to be overbearing’ or ‘likely to be not overbearing’ (there was no option for neither). |
| ACBC: ‘must haves’ and ‘unacceptables’ | These pages cropped up during the screening exercise when the software detected a potential pattern of answering. On these pages, participants were asked whether they thought certain characteristics would always result in or avoid an overbearing scale effect. |
| ACBC: Choice tournament | These pages varied in number for different respondents depending on their previous answers. They showed two concepts on each page with a list of the different levels for each of the five attributes (including images for two of the attributes). For each couple of concepts on each page, the participant was asked to choose which scheme would seem most overbearing in scale effect. This was where the participant needed to make trade-offs between the different attributes and the levels of these. |
| Select questions on scale effect | Eight pages of non-ACBC questions concerning different aspects of scale effect that couldn’t be addressed by the choice tournament part of the questionnaire. These covered: wind turbine proportion; combined elevation and distance of views; cumulative scale effects with various distributions of windfarms in relation to the context of experience; and cumulative extent of windfarms in terms of the proportion of development to open space. |
| Demographic questions | Five pages asked respondents about their age, occupation, location of residence, attitude to wind energy development, and how many windfarms they had seen in the preceding five years. |
| Concluding remarks | Two pages conveyed thanks to the participant, informing them of the next steps for the research, providing a space for them to provide feedback or comments, and telling them how to submit the questionnaire. |

#### 4.3.2.3 Distribution of the ACBC questionnaire

The ACBC questionnaire was hosted by the University of Edinburgh computer server. A link to this was emailed to a wide range of people who had shown an interest in the landscape and visual effects of wind energy development as follows:

- People within the three case study areas that had been involved with earlier stages of the research;
- People who had expressed an interest in the research during consultation, for example following a conference presentation, during an interview, or had contacted the researcher after seeing information via the internet;
- Members of the Landscape Institute and representatives of special interest groups concerned by the landscape and visual effects of wind turbines, for example NGOs such as the John Muir Trust or windfarm opposition groups; and
- Students of landscape architecture and engineering.

The questionnaire link was sent to people that covered a range of different categories of interest, including: members of the general public; landscape architects; other professionals involved with wind energy developments; local planning authority officers; representatives of windfarm opposition groups; representatives of NGOs; and students and academics. Nonetheless, as the questionnaire was targeted at those with an interest in the landscape and/or scale effects of windfarms and the sampling was not fully randomised, it was not expected that the participants would represent an even distribution of demographic characteristics such as age or location. This was accepted for two main reasons: one, because it was judged the priority should be to target people that were interested in the issue being addressed, so that these would be more familiar with the complexity of aspects involved and more likely to invest the time and effort required to complete the questionnaire; and, two, because the demographic range of respondents was not of high importance in relation to the specific research questions.

In addition to the ACBC questionnaire link being sent directly to a range of people representing different interests, the email cover note encouraged recipients to forward the link onto others that might also be interested in completing the questionnaire. Although this meant that the number of representatives from different types would vary, it was judged that it was more important to attract the maximum number of responses.

The questionnaire was circulated in two phases. This was to allow preliminary analysis of the first phase responses as a pilot, to check the questionnaire and assessment software was working well and would deliver the information required. After this initial analysis, it was confirmed that the questionnaire did not require amendment and it was therefore circulated unchanged to the second stage participants (as detailed in Appendix D.8).

#### 4.3.2.4 ACBC data analysis

Although Sawtooth software (SSI Web) and SPSS have the ability to process ACBC data in many different ways, two main methods were utilised for this research to address the specific research questions: Counts analysis and Hierarchical Bayes (HB) estimation. The different methods of data analyses are described within the following section.

*Counts analysis*

The first stage of data assessment was Counts analysis. Counts are ratio data that indicate the number of times an attribute level was chosen relative to the number of times it was available for a choice (Sawtooth Software, 2013a). These data include the frequency and percent of responses to the BYO, as well as to the 'must haves' and 'unacceptables' identified during the screening part of the questionnaire. The Counts data also identify the 'winning concept', although this is not of high relevance to this research which was not searching for a best product, as may be the case for other uses, such as in marketing.

*Conjoint utilities and attribute importance*

'Utilities' refer to a respondent's preference for an overall composition of attribute levels, termed a 'product concept'. For this research, this refers to a respondent's judgement of the landscape and windfarm composition that has most overbearing scale effect. In contrast, the utilities of the different attribute levels are referred to as 'part-worths' (Orme, 2010, p197).

Using the Sawtooth software, Hierarchical Bayes (HB) was used to estimate the utility scores. This allowed the 'borrowing' of information from every respondent within the dataset to improve the accuracy and stability of each individual's part-worth estimates (Sawtooth Software, 2013b). The utility scores were converted into measures of importance of attributes affecting the perception of the scale effect of wind turbines. During analysis of the importances of the part-worth utility scores, a Standard Error (SE) of 2.0 was applied and illustrated by the SPSS software.

Conjoint utilities are interval data and scaled to sum to zero for each attribute. This means that you cannot directly compare absolute utility levels between attributes, for example a large-sized windfarm having a part-worth utility score of 56.41 and a moorland landscape type having a part-worth utility score of 4.66 (Orme, 2010, pp.78-79). Nonetheless, you can compare levels within an attribute and differences between levels across attributes. Being interval data, the distance between part-worth utility scores is relevant; for example, the difference of part-worth utilities between 0 and 2 for one attribute is the same as between 4 and 6 for another. This is one of the particular strengths of Choice-Based Conjoint (CBC) and allows comparison of importances to be made across different attributes. For example, you can compare a difference of average importance of 63.6 between small and medium-sized wind turbines and a difference of 72.46 between a windfarm in the middle distance and far distance. In this example, you can conclude that a switch in wind turbine size from medium to small will have less effect on preference than a change in proximity from middle to far distance.

Ranges between levels of importance were analysed for each attribute to reveal the degree of difference. Some were very high, indicating a strong difference in importance between the highest and lowest levels, such as for wind turbine proximity (overall range of 130.15), whilst other ranges were much lower, such as between the different contexts of experience (overall range of 79.06).

The data on importances were analysed using SPSS software for differences and correlations, including between attributes and with the demographic and non-conjoint question data. This included statistical analysis using methods such as non-parametric tests and bivariate correlations.

Factor analysis was carried out on the data to see whether, via potential factoring of the relative importances, the data could be simplified and/or reveal which attributes might be related and which might be independent. This was undertaken following Principal Component Analysis with Varimax Rotation. Nonetheless, after initial exploration, this method of analysis was not pursued as early results did not yield information that was judged as particularly useful in relation to the specific research questions, partly because of the relatively small number of attributes.

Regression was also carried out during the data analyses to see if it could predict dependent variables from independent variables, for example respondents' attitudes to windfarms from their age. This analysis was also found to have limited value in relation to the research questions and thus not pursued further. This was partly because the ACBC data represented the relative importances of the different attributes and levels to result in a landscape effect, not to determine acceptability of this (which would be more suited to testing using regression) and partly because relationships between demographic characteristics that were easier to test were not a key issue of the research questions.

## Reflections on Section B: Research strategy and methodology

This section of the thesis that includes chapters 3 and 4 has provided a description of the overall research methodology framework and details of the three individual methods: Landscape and Visual Impact Assessment (LVIA); experiential landscape assessment; and public attitude and preference study.

This section has revealed that, within the overall methodology framework, the three different methods can be used to address the research questions in different ways. Furthermore, their combination builds upon the strengths and weaknesses of each, bridging the applicability gaps and providing triangulation. The use of case studies also allows the research to reflect different contexts in which scale and scale effects may be experienced in the landscape. The methods include a variety of research processes, including semi-structured interviews, site assessment, questionnaires and statistical analysis.

The selection of suitable methods to address the research questions was challenging and none of those chosen were completely straightforward to apply, although they varied in how much development or adjustment they required.

LVIA is a standard, well-established method familiar to many landscape architects and planners, and the method itself did not need to be modified for this research. Nonetheless, it did need to be reviewed critically with regards to its scope following standard guidance, the content of existing LVIA reports, and the sensitivities of scale effect within a landscape that should be considered by LVIA. Conversely, experiential landscape assessment is a non-standardised method and thus relatively flexible, but this meant it required specific development and confirmation to cover site assessment, semi-structured interviews, data analysis and presentation of the outputs. Finally, contrasting to the LVIA and the experiential landscape assessment, the public attitude and preference study included two questionnaires. One of these, ACBC, is well-established, but in other professions and not used commonly for landscape architecture research. Consequently, this research method had to be both fitted within a defined structure, but also developed innovatively to be used in landscape architecture. This presented particular challenges for the selection of attributes and levels, the wording of the questionnaire, the incorporation of images and subsequent data analyses.

The findings of these methods are described within the following Section C (including chapters 5 – 7). In addition, lessons-learnt from the development and application of these methods are considered further within Section D, chapter 8, as these can inform additional development and application of the research, including further development of methods to assess and communicate scale effects.

## Section C: Research findings and interpretation

# Chapter 5

# LANDSCAPE AND VISUAL IMPACT ASSESSMENT (LVIA): RESEARCH FINDINGS AND INTERPRETATION

This chapter describes the research findings for the Landscape and Visual Impact Assessment (LVIA) method. The research applied or analysed this method in four separate ways for different purposes. In reference to the problem statement and research questions, it was important that the findings of this method improved understanding of: how scale effects can be assessed through LVIA; how they have been assessed through LVIA in practice; why LVIA reports have not conveyed to people sufficiently clearly in the past the scale effects of a proposed development; and what a LVIA needs to consider in the future to address this problem.

The findings are described according to the research stages as follows:

5.1 Stage A: Review of the Guidelines for Landscape and Visual Impact Assessment (GLVIA) with regards to scale effects

5.2 Stage B: Review of existing LVIAs for windfarms

5.3 Stages C and D: Sensitivities to scale effects that should be considered by LVIA

## 5.1 Review of the Guidelines for Landscape and Visual Impact Assessment (GLVIA) with regards to scale effects

The purpose of the review of the second edition of GLVIA (referred to as 'GLVIA2') was to understand the scope of LVIA following these guidelines to assess scale and scale effects in a landscape. Understanding the scope of GLVIA in this way was important because it revealed what should and should not be expected of LVIAs following the standard guidelines. This was relevant to how LVIA could address the problem identified earlier in the research: that people often do not understand the potential scale effects of windfarms from the information provided to them.

The findings of the review of GLVIA2 within the following section are structured under the following headings:

5.1.1 A role to inform, and the benefits of a clear structure whilst allowing flexibility

5.1.2 Definition of terms

5.1.3 People's experience of scale

5.1.4 Combinations of attributes

5.1.5 Considering scale in design and mitigation

5.1.6 Dealing with different types of scale and data

5.1.7 Assessing significance of scale effects

5.1.8 Future use of GLVIA to inform assessment of scale effects using LVIA

Further details of the review are provided within Table E.1.1 of Appendix E.1, including direct references to GLVIA2.

### *5.1.1 A role to inform and the benefits of a clear structure whilst also allowing flexibility*

GLVIA2 describes the overarching purpose and importance of LVIA is to inform people - professionals, decision makers and the public - about potential significant landscape and visual effects. This applies equally to issues of scale: that a LVIA should inform people about potentially significant scale effects. To be informative, GLVIA describes how it is very important for information within a LVIA to be clear and understandable by different people. This is a particular challenge when informing people about scale and scale effects (as described within chapters 1 and 2), as people often do not understand the different ways in which they perceive scale.

GLVIA2 describes a very clear structure for LVIA. This can assist in the assessment of scale, by setting a framework within which there can be assessment of the sensitivity of the baseline conditions, the magnitude of scale effects and the significance of scale effects. As GLVIA2 provides general guidance, scale is not always raised as a specific issue. Nonetheless, similar to other aspects, it would be expected to be considered under the broad guidance principles, for example as described under the umbrella terms of existing features, characteristics and the way the landscape is experienced and valued.

GLVIA2 is very clear about separating landscape and visual sensitivities and effects and this approach has many benefits in terms of clarity. It is also useful for encouraging address of landscape issues when visual issues often attract more attention due to their relative simplicity and the appeal of accompanying illustrations. Nonetheless, issues of scale do not always lend themselves to this binary division, as the experience of scale in the landscape includes aspects of both visual and spatial scale. Two approaches can be taken: split related aspects of scale between the LIA and the VIA or, alternatively, group consideration of scale together, but separate to other parts of the LIA and VIA. Neither of these options is ideal, although this dilemma is not unique to scale and is relevant to other aspects of LVIA, such as assessment of sequential experiences along specific routes. For these subjects, it is possible to signpost how the aspect is considered across an individual LVIA. Nonetheless, there is a risk that all aspects of scale are included within either the LIA or VIA (which would be misleading) or, more concerning, that the awkward fit means some aspects of scale are not considered at all.

An important finding of the review of GLVIA2 with regards to scale was confirmation of the flexibility of LVIA as a method that can be adopted to fit different circumstances. This highlighted that there was nothing within GLVIA2 *per se* that meant that sensitivities of scale and scale effects could not be assessed comprehensively through LVIA, as long as the exact process adopted was described. Nonetheless, there are also disadvantages of this flexibility of GLVIA2: a downside being that, although the generality of the process provides plenty of scope to assess scale, the guidelines are not so explicit that they highlight the specific *necessity* of assessing sensitivities to scale and scale effects. This may mean that some assessors may not realise the importance of assessing scale and/or omit this as they cherry-pick aspects that seem more straightforward to assess.

### *5.1.2 Definition of terms*

Although GLVIA2 highlights the importance of a clear assessment process and communication, review of the guidelines revealed a fundamental problem regarding reference to scale within GLVIA2. That is that the guidelines use the word 'scale' in two quite different ways[103]: scale in terms of an attribute of the landscape or visual resource; and scale in terms of a level of effect, particularly with regards to the level of magnitude of effect. This can be confusing in parts of GLVIA2 (although it is an issue of language rather than substance), particularly where there is reference to both types of scale within the same section. Given this ambiguity, it may be possible that assessors believe they have adequately considered 'scale' as advised, but have actually only considered it in part.

GLVIA2 describes usefully how it is important that the process of LVIA is transparent and, to achieve this, terms should be explained clearly. Furthermore, it stresses the need to define levels of sensitivity and effect, and these requirements would be applicable to the assessment of scale and scale effects like other aspects. Nonetheless, it may not be realised from the general descriptions included in GLVIA2 that this is particularly important for scale and other aspects if they are relative qualities. This means a landscape or a proposed development cannot be intrinsically large or small scale, only large or small in relation to something else. For scale, this means the references need to be described clearly to avoid ambiguity.

### *5.1.3 People's experience of scale*

GLVIA2 highlights usefully the need to establish how people experience a landscape: '*what matters and why*' (p15) and this would apply to the experience of scale as to other characteristics or qualities. Nonetheless, assessing and understanding how people experience a landscape is not straightforward. This is confirmed by Churchward *et al* (2013) who state that, whilst there is widespread recognition that public attitudes need to be taken into account, there is less clarity of how to best achieve this. This means that, whilst following GLVIA2, it might be expected that public consultation would be required to establish how people experience a landscape, but the guidelines are not explicit about this. This may be to leave sufficient scope for alternative processes to obtain the data required, but it can also lead to uncertainty about expectations, ie: is consultation with local people required or can sufficient information be obtained using professional assessment only, or is there likely to be sufficient information provided through EIA Scoping?

[103] Scale is also used on a few occasions to refer to different geographical levels, for example national scale and regional scale, but this is relatively rare and usually distinguished clearly.

### 5.1.4 Combinations of attributes

GLVIA2 describes how to assess baseline conditions and sensitivity. It is useful that this information is clearly structured, but this also means that there may be a tendency to consider characteristics in a fragmented manner. This is particularly relevant to the assessment of scale because it is a relative quality and relies on making scale references between spaces and characteristics, meaning it is very important to understand how these combine and their relative importance. Without clear guidance on this, it may be difficult to know how to assess multiple influences of scale in different places or at different levels. For example, a landscape may include enclosed, framed or open views and be experienced from different elevations in relation to different topography.

GLVIA2 may also encourage fragmentation in the description of the users of a landscape. Whilst it is helpful that it highlights the need to assess different users with regards to sensitivity, it does not also highlight that users may be undertaking multiple uses at different times and in different ways. For example, a local resident may partake in recreation and/or live or work within a community affected by a windfarm and/or travel past a windfarm. These multiple activities by different people are particularly important with regards to scale, as perception of scale in a landscape is formed whilst experiencing it from different places, at different times and whilst undertaking different activities. This means the descriptions in GLVIA2 of categorising separate user types may not be helpful in encouraging assessors to consider all the ways in which people experience a landscape.

### 5.1.5 Considering scale in design and mitigation

GLVIA2 provides clear advice on the importance of siting and design during development of a proposal and also how mitigation should be incorporated. Although it does not mention scale explicitly in this respect, following the general guidance would require alternative scales of a development to be explored in relation to the sensitivities of the baseline conditions and how these are experienced. In addition, where significant adverse effects are identified, both directly and indirectly, GLVIA2 advises that these should be mitigated where possible, which would also include mitigation of adverse scale effects.

### *5.1.6 Dealing with different types of scale and data*

GLVIA2 describes how an assessment of both landscape and visual effects should be based upon quantitative and qualitative data, which would also be relevant to the assessment of scale effects. Nonetheless, it does not explain how to combine and/or judge the relative importance of these different types of data which can be very challenging. In addition, with regards to scale, there tends to be focus upon quantitative examples within the guidelines, such as the extent of a view or the size of a building, rather than qualitative data such as a perceived overbearing effect upon a sense of enclosure. This could be partly responsible for assessors focusing upon more straightforward quantifiable aspects, rather than qualitative aspects. In addition, focus upon quantitative aspects within their assessments, such as numbers of elements, may lead to an implication that these are directly linked to resulting scale effects, which is not always the case, nor reflects that scale references may be made in relation to a norm or other elements as well as to a range or measure.

### *5.1.7 Assessing significance of scale effects*

Guidance is provided within GLVIA2 on judging the significance of landscape and visual effects and there is mention of scale as a relevant factor within this, for example: '*the degree of contrast or integration of any new features or changes in the landscape with the existing or remaining landscape elements and characteristics in terms of form, scale and mass, line, height, colour and texture' (p91)*. In addition, with regards to the compatibility of effects, GLVIA2 describes how '*large-scale changes which introduce new, discordant or intrusive elements into the view are more likely to be significant than small changes or changes involving features already present within the view'* (p95). Whilst these kinds of descriptions are useful for raising scale as an issue, they also highlight some of the problems of ambiguity of reference, with scale being described in terms of the 'scale' of the object, in relation to the 'scale' of the receiving environment, and the 'scale' or magnitude of effect and what this may mean in terms of compatibility of scale. This means that it can be unclear what aspect of scale is being referred to within different parts of the guidelines on the significance of effects and how this relates directly to scale in terms of baseline conditions, a proposed development and magnitude of effects.

The examples provided by GLVIA2 with regards to significance of visual effects are useful for mentioning the implications of scale, not just the level of effect, for example discordancy or intrusion (p95). Nonetheless, describing only either ends of a spectrum can lead to difficulties of application, as there is no advice on the different effects and the thresholds that exist in-between the extremes and that tend to be relevant to most developments. This is particularly important if thresholds between various scale effects are not evenly spaced.

### *5.1.8 Future use of GLVIA to inform LVIA of scale effects*

Consideration of GLVIA for this research needed to take into account two separate editions of the guidelines because, whilst the second edition (2002) was current at the outset of the research and had been followed by the LVIA reports reviewed for this research (described in the following section 5.2), the updated third edition was also relevant for LVIA that would be carried out in the future. For this reason, the third edition of GLVIA (2013) was also reviewed in terms of the advice and scope it presents for the assessment of scale and scale effects. The findings of this review are summarised within Table E.1.2 of Appendix E.1 and discussed further in chapter 8.

## 5.2 Review of existing LVIAs for windfarms

This stage of the research reviewed existing LVIA reports to understand how these included assessment of scale and scale effects in the landscape and the experience of these within the scope provided by GLVIA2. This review was carried out in two stages, including initial broad-level review of five existing LVIAs within Scotland and later detailed review of the LVIAs produced for the case studies. The assessment reports were reviewed in relation to the pre-defined criteria (listed in Tables D.1.4 and D.1.5 of Appendix D.1). Key issues raised by this review are described within the following section.

### *5.2.1 Process of assessment, including definitions of levels of effect*

The LVIAs reviewed were found to generally follow the standard process described within GLVIA2 to identify the sensitivities of the landscape and visual resource and the magnitude and significance of effects. Nevertheless, none of the LVIAs assessed the full range of relevant landscape and visual sensitivities and effects of the proposed windfarms, including scale effects. Typically, they included a large amount of description of characteristics, but with little analysis and interpretation (ie the LVIAs described the *what*? But they did not fully explain the *why* or *how*?) This meant that the LVIAs typically did not assist in-depth understanding of either the sensitivity of the baseline conditions with regards to scale in relation to the proposed development, or the resultant scale effects.

One of the biggest problems concerning consideration of scale by the LVIAs was found to be terminology and the definitions and understanding of what was being described. For example, many of the LVIAs referred to scales of landscape, such as being of 'large scale' or 'medium scale', but the basis for these judgements was unclear (especially when the landscapes were not described in this way within the Landscape Character Assessment (LCA) for the area). Typically, it seemed these terms were associated with an assessment of openness or the massiveness of the landform, but this was not made explicit. In addition, description of these characteristics often varied in relation to the level or 'scale' at which the landscape had been assessed. For example, at a very broad level, a range of hills may have been assessed as large in landform, even though they contained some deeply incised local glens in which the perceived spatial scale of the landscape was very different. When imprecise terms are used in LVIAs, a common criticism is that this reflects poor writing skills or style[104], but it seemed from this review that it may have instead reflected a lack of detailed analysis or understanding by the assessors. This follows Arnheim's suggestion (1974) that we can only name what we have registered and that our experience must be coded by perceptual analysis before it can be named (p2).

GLVIA2 explains that LVIAs need to define levels for receptor sensitivity as well as levels of magnitude and significance of effect, but this review of LVIAs found that many of the thresholds for these levels were indistinct, undefined or ambiguous. In addition, although some of the LVIAs did mention aspects of scale as being an influencing factor for their judgements of sensitivity, magnitude or significance, the actual determinations made for proposed developments seemed to align more closely to summary tables for levels that rarely included scale as a criterion. Thus it was found that there was typically no clear

[104] For example with a recommended need for 'plain English' raised during a question and discussion session at a Landscape Institute GLVIA training course, 13 January 2016, York.

indication of how scale issues directly influenced the different levels of sensitivity, magnitude or significance. Indeed, it was found that the LVIAs relied most strongly on measures of value to determine sensitivity and measures of prominence (for example 'noticeable' or 'very noticeable'), distance or extent to determine magnitude and significance of effects.

The ambiguity of the levels of resource sensitivity and magnitude or significance of effect with regards to scale was found to be confused even further by many of the LVIAs referring to levels of effect that lay in-between the defined levels. For these in-between levels such as 'slight to moderate' it was not clear whether the effect was predicted to be half way in-between the two levels, one level in one respect and a different level in another, or whether the assessor was just indecisive. Additionally, for some effects, a supplementary qualification was applied, such as stating that a certain effect would be 'local' or 'localised'. This caused difficulties in two ways: one, these terms were not defined; and two, extent of effects was included within the measure for magnitude of change, so adding geographical limits to the judgement of significance of effects represented double-counting.

Where scale effects were included in the descriptions of effect within the LVIAs reviewed, this was typically as just one of a large number of separate aspects. Consequently, it was difficult to understand how scale effects combined with other effects and would be experienced in different places by different people. Most importantly, this meant it was not possible to make a direct link between the sensitivity of the resource to scale, the effects of the development proposed in direct relation to these sensitivities, and thus how this would affect the key receptors and the experience and value of the landscape by people.

### *5.2.2 Sensitivities of the landscape and visual resource to scale effects*

Within the Landscape Impact Assessment (LIA) part of the LVIAs, it was found that the main sensitivities to scale identified were an overall judgement of the 'scale of the landscape' but none of the LVIAs described what was meant by this. There seemed to be some correlation with descriptions of the landform, as described previously, for example 'large scale' landscapes being associated with high hills, massifs, plateaux or moorland and/or a high degree of openness or exposure, although this was not made explicit. Conversely, within the Visual Impact Assessment (VIA) part of the LVIAs, the main sensitivities to scale identified were existing features or elements within the landscape, such as buildings, trees or landform features. The main problem with these descriptions was that scale tended to be described in terms of relative measures or units, as if views of a landscape are static and two-dimensional like a painting, and without taking into account perception of distance or spatial characteristics.

Remarkably, in all of the LVIAs, there was rarely any description of the experience of scale effects in different places by different people, for example as influenced by different orientations, elevations, along different routes, or perceived enclosure. In some LVIAs there was description of spatial character in general terms, such as a landscape being open. Nonetheless, although this was sometimes followed by an explanation that this would heighten prominence of a windfarm, there was no similar explanation within the LVIAs of how openness may be valued as a spatial quality (The Research Box, LUC and Minter, 2009). In addition, whilst there was mention in some of the LVIAs of scale indicators and these were highlighted as being important, their relevance in terms of scale perception was not explained. This meant it was unclear what the implications would be of having these indicators, for example in terms of cues for estimating the scale of wind turbines, and what this would mean for the resultant scale effects.

Although GLVIA2 states clearly that assessment of the sensitivities of a landscape resource should include consideration of how this is experienced, the LIA part of the LVIAs reviewed focused on mainly or only the direct physical effects of a development. Furthermore, many of the LIAs considered landscape sensitivities only within the single landscape character type in which the development was proposed, rather than considering these within all the landscape character types from which a development would be experienced and likely to result in significant effects, both singularly and in combination with others.

With regards to the sensitivity of scale, this review found that perceived distance within a landscape rarely seemed to be considered by the LVIAs (although measures of distance were mentioned when assessing magnitude of effects), despite this being very important in terms of the likelihood of a structure being perceived as overbearing upon different receptors. Similarly, it was found that spatial edges within the landscape were rarely recognised despite these being important in terms of seeming to separate a windfarm from receptors, the potential for a windfarm to create a new edge within an open landscape, or reinforcement or breaching of an existing edge.

Interestingly, through review of the capacity study for case study C, it was found that this strategic study identified sensitivities of scale better than the case study LVIAs. This is possibly because, without the focus of a specific proposal, the assessors found it easier to look at the wider landscape context and how it was experienced, whereas those carrying out the LVIAs may have been more focused on a specific development proposal. This follows useful guidance on judging thresholds of effects for capacity and sensitivity studies provided by SNH and the Countryside Agency in their Topic Paper 6 (2002c). Nonetheless, because this research included review of only one capacity study, it is not possible to know whether this finding is representative of a typical difference between LVIAs and capacity studies.

A key shortcoming of the LVIA reports was that, despite a large amount of text being included and a wealth of description, much of the information concerning perceived characteristics or qualities included insufficient explanation. Although a LVIA cannot be expected to explain in detail the understanding of effects that a professional assessor will have due to their training and expertise, it was nonetheless found that many of the LVIAs just made isolated statements regarding scale and expected the reader to 'join the dots' and come to their own judgement regarding the relevance. For example, they might mention elements of the landscape pattern influencing the perceived scale of an adjacent windfarm, but with no explanation of how or the relative importance of this effect.

### *5.2.3 Considerations of windfarm siting and design with regards to scale effects*

From the review of LVIAs, it was found that most do not include analysis of the most appropriate size of wind turbine following identification of the sensitivities of the landscape and visual resource and, instead, seem to just adopt the wind turbine size that has been proposed by the developer[105]. In addition, where LVIAs did consider alternative wind turbine sizes (such as case study B), this tended to be because there was a need to be compatible with other windfarms within an area or to justify a wind turbine scale different

[105] Typically identified at an early stage based on wind resource and potential maximum output

to the norm[106], rather than part of a general process of selecting the wind turbine size that would be most suited to the scale sensitivities of the landscape and visual resource. Thus, in these cases, the alternative sizes explored did not usually relate to different thresholds of scale effect[107]. Furthermore, none of the LVIAs included exploration of alternative wind turbine proportions in response to the landscape and visual sensitivities.

Although most of the LVIAs included little consideration of alternative wind turbine sizes, most of those reviewed described how a number of different numbers and extents of wind turbines had been assessed as part of the design process[108]. Typically the scope for these alternatives was limited by the site boundary and ground constraints such as peat depth, slope, habitats and drainage. Nonetheless, a number of alternatives were mapped and described within most of the LVIAs, with the changes explained as mainly to improve the visual cohesion and balance of a scheme and/or to limit or remove visibility from particularly sensitive viewpoints. In addition, some of the LVIAs described relocating wind turbines to be further away from key access routes and houses, which may have been to reduce scale effects, although this was not made explicit. There was also reference within some of the LVIAs to limiting the total extent of wind turbines in relation to the scale of the landscape, although the scale references described were not consistent, for example describing both trees as well as broad hill ridges as influences.

### *5.2.4 Descriptions of the residual scale effects of a windfarm*

Through the review of LVIAs, it was found that the scale effects of the proposed developments were rarely identified or assessed specifically. Conversely, many of the LVIAs just described quantifiable elements within their assessment of the magnitude of visual effects, such as the number, distance and/or proportion of wind turbines visible from key viewpoints, their horizontal extent in views, and over what area they would be seen. From this information, the reader was then expected, presumably, to make a judgement of the significance of these effects without information on how they would be perceived collectively and in relation to the baseline conditions. In addition, none of the LVIAs

[106] For example, for case study B, the wind turbines proposed would have been the highest in Scotland at the time if approved, so the developer also explored using a smaller size that was common at the time.
[107] Apart from one threshold of wind turbine size identified in the capacity study for case study C for categories above and below 35m
[108] Although the main prompt for this was often obtaining the best layout of the wind turbines

assessed or described in any detail the influence of scale effects on people's experience of the landscape in different places and whilst undergoing different activities.

Review of the LVIAs found that the only scale effect of windfarms that was described by most reports (although not comprehensively) was the visual scale of the wind turbines in relation to other elements seen in some specific views, for example as a proportion of the visible height of a hill. In this respect, the relative distance of elements or spatial characteristics were rarely mentioned, so that the effects described seemed abstract, almost as if a view of the landscape was two-dimensional. Indeed, it is possible that this may reflect that some assessors had referred to photographs of the landscape when making their assessment, rather than assessing scale effects in the field where the influence of distance and spatial characteristics would be much clearer and possibly seem more influential.

Despite the limited amount of information regarding scale and scale effects included within the sensitivity assessment or the assessment of magnitude of landscape and visual effects, several of the LVIAs nonetheless included statements within the conclusions of the LVIA that made reference to scale. For example: '*The windfarm would appear as a small-medium-sized windfarm of a reasonable and compatible scale, given the large-scale and open character of the existing landscape';* and *'it is also considered that the windfarm group is of a reasonable scale when compared to the landscape setting and scale of existing foothills and moorland'* (pp 46 and 48 of the LVIA for the case study A windfarm). These kinds of statement suggest that the assessor was considering the scale of the landscape and that they came to a conclusion with regards to the magnitude and significance of scale effects of the proposal, but they just didn't explain or describe the basis for this assessment within the LVIA.

Many of the LVIAs included in their conclusions a summary of 'overall effects' but the basis of these judgements were typically unclear, for example whether it involved averaging of all the separate effects over the whole study area. This is a particularly important issue with regards to scale effects because it may be that, if the scale effects of a windfarm are significant and adverse, then a scheme may be unacceptable whatever its other effects. Although none of the LVIAs that were reviewed explained how scale effects contributed to the overall significance of landscape and visual effects described, some did mention how the acceptability of effects related to compatibility with the landscape and visual baseline conditions and the ability to 'accommodate' the development without significant change to landscape character.

## 5.3 Sensitivities to scale effects that should be considered by LVIA

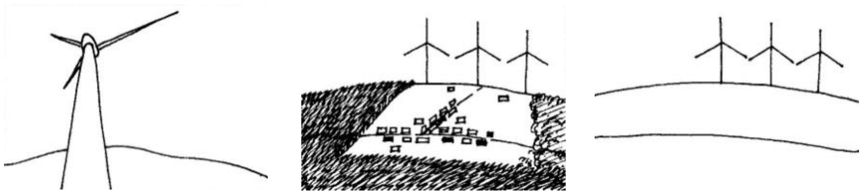
The process of identifying sensitivities to scale effects that should be considered by LVIA occurred in two stages. The first stage (C) involved assessing 25 existing windfarms across the UK that demonstrated both positive and negative scale effects. Following assessment of the individual windfarms on site, the findings from this stage were analysed and structured into nine categories of 44 attributes in total (listed in Table E.2.2 of Appendix E.2) and a report of the preliminary findings was prepared and distributed to a range of consultees[109] for feedback. The second stage (D) involved assessing each of the case study areas on site for their sensitivities to scale effects that had not been identified and/or assessed in detail in the existing LVIA reports (prepared by landscape consultants), but for which the review of GLVIA had identified scope for assessment. The interim findings of this assessment were combined with those of the experiential landscape assessment where they overlapped, to produce interim reports for each of the case study areas that were circulated for consultation and feedback.

Categories of the findings from both these stages of assessment are listed in Table 5.1 overleaf, followed by descriptions of these within the subsequent Table 5.2. The findings of the two different stages are combined within these tables to bring together the total range of sensitivities to scale effects identified through the research. Nonetheless, it is useful to highlight which sensitivities came from which stage and, for this reason, the titles of the sensitivities are coloured blue when derived from the first stage C and coloured green when derived from the second stage D. By comparing these, it can be seen that the earlier stage assessment identified more sensitivities that were individual attributes (partly because of the broader level of assessment and wider range of landscapes and windfarms assessed), whilst the later stage assessment within the case study areas identified more sensitivities related to how attributes combined and were experienced.

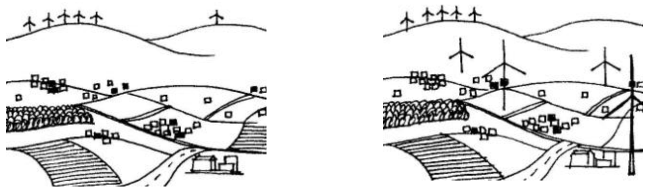
[109] Including landscape and planning advisors from a local Planning Authority, National Park, SNH and a windfarm developer.

| Table 5.1: Categories of research findings on sensitivities to scale and scale effects that should be considered in LVIA | |
|---|---|
| | *Category* |
| **Spatial characteristics and experience of the landscape** | |
| 1 | Relationship between windfarm and the scale of spaces and people |
| 2 | Distance, access and vantage points |
| 3 | Influence of elevation of viewpoint on scale estimation and effects |
| 4 | Scale of landform edge |
| 5 | Perceived scale of extent of a landscape |
| **Legibility of the landscape scale and landscape pattern** | |
| 6 | Landscape pattern and cues for perceiving distance |
| 7 | Visual relationship to the landform skyline |
| 8 | Relationship between windfarms and the scale of woodland and screening by this |
| 9 | The influence of landscape pattern on scale indication and perception of an overbearing scale effect |
| 10 | Influence of landform or woodland on the visible scale of wind turbines |
| **Landscape type** | |
| 11 | Varying relationship to landscape characteristics and landscape character type |
| 12 | Relationship between wind turbines and other vertical features |
| 13 | Pattern of large scale features |
| 14 | Shape and scale of the landform |
| **Windfarm type** | |
| 15 | Wind turbine proportion |
| 16 | Variation of wind turbine size |
| 17 | Extent of windfarm |
| 18 | Wind turbine orientation and lighting |

Although this stage of the research is concerned with identifying sensitivities to scale effect, it was found to be often easier to demonstrate these sensitivities in Table 5.2 by describing and illustrating the potential effects of a windfarm. In addition, despite the assessment of sensitivities within the case study areas being based upon both existing and proposed or potential windfarms, the wording in Table 5.2 refers consistently to existing windfarms for ease of explanation.

<table>
<tr><th colspan="2">Table 5.2: Sensitivities to scale effect identified through site assessment that should to be considered by LVIA</th></tr>
<tr><th>Category of scale effect</th><th>Description of sensitivities to scale effect</th></tr>
<tr><td colspan="2">Spatial characteristics and experience of the landscape</td></tr>
<tr><td>1<br><br>Relationship between windfarm and the scale of spaces and people</td><td>A perceived overbearing scale effect was found to be influenced by the scale of spaces and perceived enclosure, influenced by landscape elements such as woodland and buildings. At close proximity, the scale of a space (relevant to wind turbine scale) was not always clearly apparent while, at a further distance away, this was often easier to discern.<br><br><br><br>Close by, looking up at a wind turbine, it is difficult to appreciate the relationship of this to the surrounding space<br><br>Windfarm appears overbearing upon distinct space created by surrounding woodland, clearly visible from a distance<br><br>In the same location, without woodland and settlement, a windfarm seems less overbearing upon the surrounding space<br><br>Figure 5.1: The relationship between windfarm scale and the perceived scale of spaces<br><br>Perception of an overbearing scale effect was also found to be influenced by the presence of people within the surrounding spaces. For example, views of wind turbines towering above houses prompted a ‘third party’ concern for perceived overbearing scale effects upon residents that was not the same when seeing turbines towering above trees or industrial buildings.</td></tr>
<tr><td>2<br><br>Distance, access and vantage points</td><td>The distribution of access routes and vantage points was found to affect the perception of scale, as numerous views at varying distance and/or from varying directions provided multiple cues that could be considered in combination. It was found that this kind of experience was more common within settled, managed and/or agricultural landscapes where the network of access routes tended to be more dense and evenly-distributed.</td></tr>
</table>

***…Distance, access and vantage points***



Scale of wind turbines is less clear where these are seen upon hills that are not easily accessible and typically appear distant from most public viewpoints

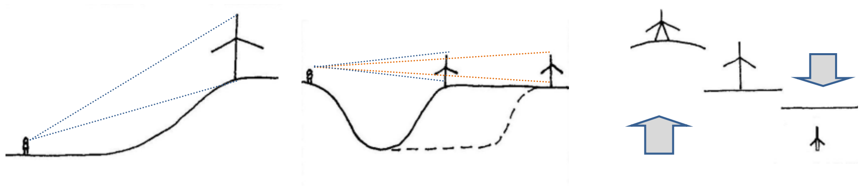
Scale of wind turbines within settled landscape is perceived by many at various distances and directions, contributing to a more informed perception of scale. These close windfarms may also be used as a cue to inform perception of more distant windfarms (whether of similar dimensions or not).

Figure 5.2: Perception of scale based on accessibility and proximity

The accessibility of the landscape was also found to influence perception of scale through judgements of distance calculated by combining travel speed and progress through the landscape towards a development.

**3 Influence of elevation of viewpoint on scale estimation and effects**

Perceived wind turbine scale was found to be made in reference to both the top and bottom of a wind turbine. As the angles in-between these were greatest at lower or higher elevations, it was most difficult to make an estimate of scale from these locations, whilst it was easier from places of similar elevation to the wind turbines. The influence of viewing angle was affected by distance, as upward or downward angles of a view are reduced over greater distances.



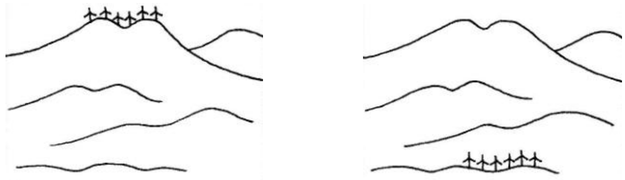
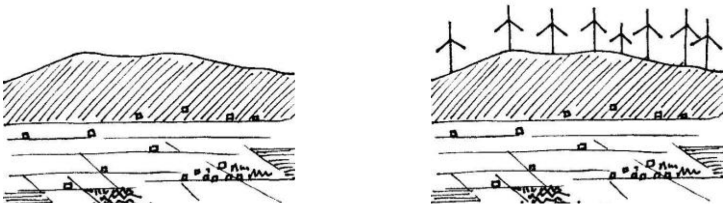
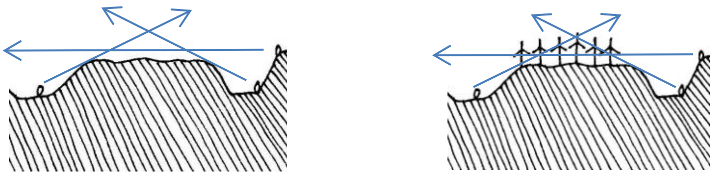
Angled view looking up or down to a wind turbine

Narrower angle of view with distance

Different appearance and vertical emphasis of wind turbine when looking up, across or down to it

Figure 5.3: Influence of elevation and viewing angle when perceiving wind turbine scale

The overbearing effect of a windfarm was found to be reduced when looking down towards it whilst, conversely, this was greater where wind turbines were located at higher elevations than the viewer.

| | |
|---|---|
| ***… Influence of elevation of viewpoint on scale estimation and effects*** | <br>Figure 5.4: Different perceptions of scale effect based on relative elevation of windfarm and viewer |
| **4**<br>**The scale of landform edge** | Where hills lie adjacent to a low area (landscape, seascape or firth) it was found that windfarms could diminish the perceived scale and distinct edge formed by the hill backdrop. In this way, windfarms could appear to ‘breach’ the distinct edge that previously seemed impenetrable and thereby seemed to shield and define the spatial qualities of the adjacent area.<br><br>Figure 5.5: Original edge and containment of lowland area by adjacent hills appears ‘breached’ by the location of a large windfarm |
| **5**<br>**The perceived scale of extent of a landscape** | Where the scale and position of a windfarm results in it being seen upon the skyline from a number of different viewpoints from different directions, it was found that this can act as a reference point that indicates the extent of the surrounding landscape. Greatest sensitivity to this effect occurred in landscapes that were previously perceived as extensive, despite being relatively small in dimensions, because of an inability to see the far edge of the area due to screening. This often occurred within moorland or hill landscapes which were perceived as being infinite in scale when viewed from surrounding glens or edges, as shown in Figure 5.6 below.<br><br>From either side of hills, extent seems infinite as no markers to define far edge<br>From either side of hills, visibility of windfarm provides landmark seen from all directions, indicating the actual small extent of the area<br>Figure 5.6: How a large windfarm may diminish the perceived extent of a landscape.<br>Although existing good practice guidance highlights that the scale effects |

***… The perceived scale of extent of a landscape***

of a windfarm are influenced by the scale of the land or adjacent water (for example SNH, 2014a), it was found that the perceived scale effects of windfarms were also strongly influenced by how the scale of these were seen in relation to the extent of sky visible within different views (that typically relates to the elevation of the viewer, landform and land use). The amount of sky within a view also contributes strongly to the sense of openness and exposure upon elevated sites and whether the foci of views tend to be within the foreground, midground or background.

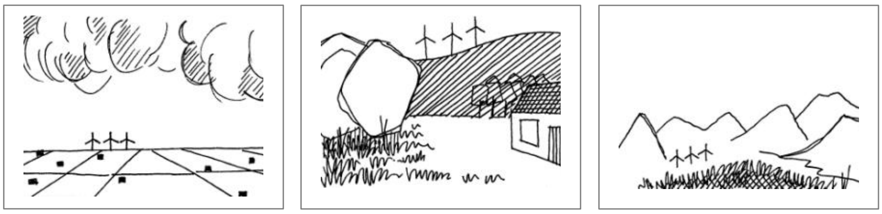


Figure 5.7: The influence of the amount of sky within a view upon the perceived scale effects of a windfarm

**Legibility of the landscape scale and landscape pattern**

**6 Landscape pattern and cues for perceiving distance**

Following the theoretical background, it was not unexpected that elements of landscape pattern such as fields, roads, trees and power-lines visible over a wide area helped perception of scale, acting as distance cues. Nonetheless, site assessment revealed that interpreting these cues was not always straightforward. For example, windfarms were often located upon hills where a combination of cues existed, such as with simple vegetation upon a hill elevated above a contrasting and more regular landscape pattern. It was found that being able to perceive distance across the patterned part of the view, but not over the simpler hill, highlighted the vertical aspect of the hill landform and, thereby, emphasised the vertical scale of wind turbines in relation to this.

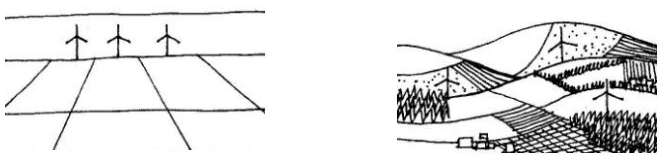
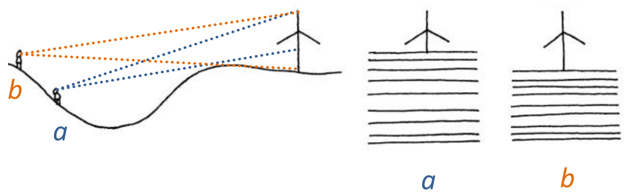
Distance easier to perceive where there is a distinct and repeated pattern of elements extending to the windfarm

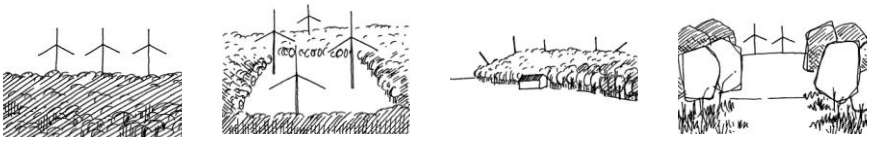
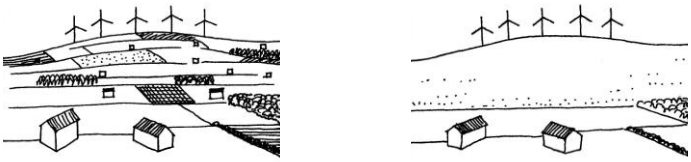
Estimation of distance is much more difficult where there is a simple ground/ sea texture.

The contrast of a hill in form and landcover may accentuate the vertical scale of the hill as well as the vertical scale of wind turbines on top

Figure 5.8: Elements of landscape pattern and landform influencing perception of scale

It was not unexpected that the vertical form of wind turbines was found to be highlighted in clear contrast to a simple landcover and/or horizontal emphasis of land or seascape. Nonetheless, although people had in the past highlighted how wind turbines may be less prominent where seen against a mixed backcloth, it was found that it was also more difficult to

<table>
<tr><td>…Landscape pattern and cues for perceiving distance</td><td>perceive the scale of wind turbines seen against a variable landscape pattern and landform, as shown in Figure 5.9 below.<br><br><br><br>Figure 5.9:  Clarity and emphasis of vertical form against different backgrounds</td></tr>
<tr><td>7<br>Visual relationship to the landform skyline</td><td>The scale effects of wind turbines were found to be influenced by how these were seen in relation to the landform skyline.  Although the vertical emphasis of wind turbines often seemed greater where seen upon a simple skyline, this did not mean that the perceived scale effects of those seen behind or below a skyline were reduced.  For although LVIA reports often described scale effects in terms of the amount or proportion of wind turbines visible above a skyline, this stage of the research found that also important was the ability to perceive distance of the wind turbines, object recognition and the awareness of scale from many viewpoints experienced within a landscape.  This meant that perceived scale effects could be based upon the full size of a wind turbine even if only part of it could be seen from a specific viewpoint.<br><br>A complex relationship between the landform and the visible skyline was observed in some locations which influenced perception of the distance and scale of wind turbines.  If the wind turbines were set far beyond the landform skyline viewed yet the intervening ground was screened, wind turbines were often perceived to be smaller rather than more distant (as shown in Figure 5.10 below).  Nonetheless, this depended upon the landform shape, the elevation of the viewer, the proportions of the wind turbines, and other distance cues.<br><br><br><br><br>Figure 5.10:  Relationship between landform and perceived scale of wind turbines seen beyond the skyline</td></tr>
<tr><td>8<br>Relationship between windfarms and the scale of woodland</td><td>A windfarm was found to often vary in its spatial relationship to woodland and trees, similar to that of a variable landform.  Typically windfarms seemed to relate to the horizontal scale of extensive conifer plantations, but not their vertical scale.  Conversely, they typically appeared overbearing in both horizontal and vertical scale in relation to the smaller scale spaces created by native or policy woodlands and hedgerows that tend to occur in lowland areas and may contribute to a perception of</td></tr>
</table>

<table>
<tr>
<td>and screening by this</td>
<td>shelter, tranquilly and/ or refuge.<br><br>Within areas of variable screening by woodland, wind turbines were often found to create a confusing perception of windfarm scale as the proportions and numbers of wind turbines were variably screened and revealed from different parts of the surrounding landscape. In addition, framing of views towards windfarms by woodland influenced the prominence of these.<br><br><br><br>Partial screening of wind turbines by woodland (although the extent is not clear)<br>Windfarm scale perceived in relation to open space upon which it seems overbearing<br>Almost complete screening of windfarm, with just blades seen ‘popping’ up above<br>Framing by woodland amplifies prominence<br><br>Figure 5.11: Variable scale effects of same windfarm seen in relation to variable woodland spaces and screening</td>
</tr>
<tr>
<td>9<br>The influence of landscape pattern on scale indication and sense of imposition</td>
<td>The distribution of landscape elements between a viewer and a windfarm was found to have a strong bearing on perceived scale effect. This reflected two contrasting influences: the first concerned perceived overbearing effect upon elements seen surrounding a windfarm; and the second concerned perceived overbearing effect directly upon a viewer. For example, as shown in Figure 5.12 below, a windfarm seen at a distance within a settled landscape may seem to have an overbearing scale effect upon the human elements surrounding it, but be perceived to be clearly distant from the viewer and thus not overbearing upon them directly. Conversely, in a landscape where there are no human elements surrounding the windfarm, it can seem less overbearing upon its immediate surroundings, but it can be perceived as more overbearing directly upon the viewer who cannot be assured that the windfarm is distant.<br><br><br><br>Figure 5.12: Varying influence of landscape pattern upon perception of overbearing scale effects<br><br>This perceived direct scale effect upon a viewer does not only occur in open areas which lack scale cues, such as over moorland or water, but also across wooded areas as the trees screen the underlying ground, as shown in Figure 5.13 overleaf.</td>
</tr>
</table>

***…The influence of landscape pattern on scale indication and sense of imposition***

Figure 5.13: Alternative scale effects influenced by both perceived distance and vertical scale, affected by visibility of scale and distance references

Figure 5.13 also highlights how our perception of the vertical scale of wind turbines is strongly influenced by being able to see distance cues extending between us, as a viewer, and a windfarm. Wind turbines seen beyond intervening screening such as by woodland may seem smaller, as the only vertical scale references that can be used are foreground features, but they may also appear much closer in the absence of distance scale cues and thus seem more overbearing through their perceived proximity upon the foreground space and viewer. With these dual influences on perception of scale and scale effects, it was found in these situations that the significance of the scale effect was based upon whether receptors were more sensitive to perceived vertical scale or proximity of wind turbines.

**10**

**The influence of landform or woodland screening on the visible scale of wind turbines**

Whilst it was expected that the character of a hill landform would affect the visibility of wind turbines from surrounding areas, it was less expected that screening by landform convex slopes or woodland would mean that windfarms sometimes had higher scale effects at far distances than middle distances. This supported the theory that the level of scale effect is not directly proportional to distance[110]. In the field, this sometimes resulted in surprising visibility of what seemed to be larger wind turbines when further away, as shown in Figure 5.14 below.

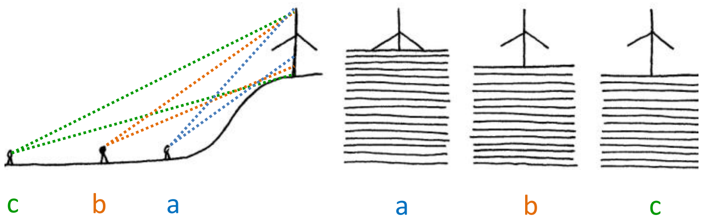
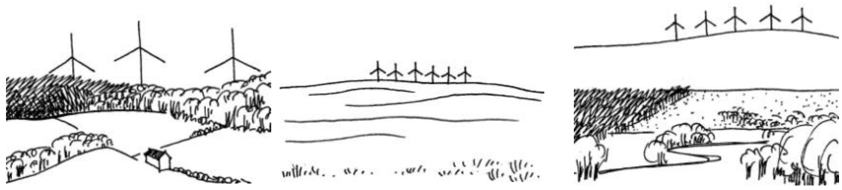



Figure 5.14: Wind turbines seem larger from further distances if visibility is influenced by partial screening by the landform

[110] Discussed in section 2.4 of the theoretical background chapter 2.

<table>
<tr><th colspan="2">Landscape type</th></tr>
<tr><td rowspan="2">11<br><br>Varying relationship to landscape character-istics and landscape character type (LCT)</td><td>A windfarm was often seen from different landscape character types whilst moving through the area or visiting different locations, for example seen in some views beyond a foreground of agricultural fields and from elsewhere beyond forested slopes. The scale of the windfarm appeared different from these different locations based upon the context in which it was viewed, including various spatial characteristics. For example, from upland areas, a windfarm may be seen in relation to high and extensive upland plateau and surrounding open space and thus seemed relatively modest in scale. In contrast, from lower-lying, smaller scale and/or semi-enclosed areas, the windfarm may be often screened but, where seen, appear overbearing due to its perceived intrusion upon enclosed spaces. In between these extremes, the scale effects of a windfarm was strongly affected by perceived separation or ‘set back’ from enclosed locations.<br><br>An important finding was that perception of the scale of a windfarm was formed by a composite of these different relationships. In this way, the experience of the scale of a windfarm in one location influenced the perception of scale effect from another[111], but not as an average. So, if a windfarm had an overbearing effect within one landscape character type, it would influence the perception of it when seen from another where its scale seemed more modest.<br><br><br><br>Figure 5.15: Variation in the scale effects of a windfarm where experienced and seen in relation to different scales of spaces within the landscape<br><br>Where a windfarm was seen from several different landscape character types with different scale characteristics, its visibility from all these was found to diminish the perceived distinctiveness of the different character types.</td></tr>
<tr><td>Where a windfarm was located within one landscape character type juxtaposed with another, the nature and extent of the scale effects were found to be related to the extent of the landscape character type in which it was located and its position within this. For example, if the area in which it was located was not sufficiently large to accommodate the scale of the windfarm (height or number/extent) plus a surrounding buffer[112], the scale effects of the development would seem to directly affect adjacent landscape character types and potentially seem overbearing in scale upon these.</td></tr>
</table>

[111] Especially if the windfarm scale was not clear in another, for example due to partial screening
[112] As described within section 2.5 of the theoretical background with reference to Crowe (1958)

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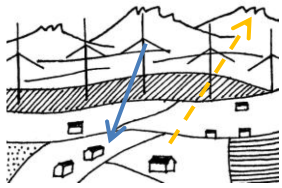
| ***…Varying relationship to landscape characteristics and landscape character type (LCT)*** | As an example, the case study B windfarm was proposed within an area of conifer forest part-way between higher hills and lower settled landscapes and was found to appear overbearing upon the scale of the adjacent settled crofting areas, whilst also being seen from these areas to diminish the perceived towering scale of distant mountains, as shown in Figure 5.16 opposite.  Figure 5.16: Contrasting scale effects in relation to adjacent landscape types |
| **12 Relationship between wind turbines and other vertical features** | As described within the theoretical background, people use references where available to assist their perception of scale. Therefore it was not unexpected to find that it was easier to estimate the scale of wind turbines where these were located in landscapes that contained other vertical features that were of consistent size or made-up of units that could be related to the human scale. Nonetheless, scale estimation in this way in relation to features such as houses or trees was found during this stage of the research to be more difficult than often implied in guidance (for example SNH, 2014a). This was usually because of the wide disparity between the scale of a windfarm and other human elements and the difficulty of discerning distances between these.  Scale references of similar size and close by, so scale comparison is easy<br>Scale references of disparate scale and distant, so scale comparison is very difficult<br>Figure 5.17: Contrasting ease of using scale references |
| **13 Pattern of large scale features** | Although the location of a windfarm upon elevated ground responds to its specific function of harnessing the wind resource, this was found to often contrast to the characteristic pattern of large built elements within Scottish landscapes. Conversely, large structures are typically concentrated within the glens, straths, lowland areas and/ or along the coast. This means that a windfarm often appears incongruous in relation to existing large scale features and are perceived as being overbearing upon the hills if these previously acted as an open and undeveloped buffer to other structures. |

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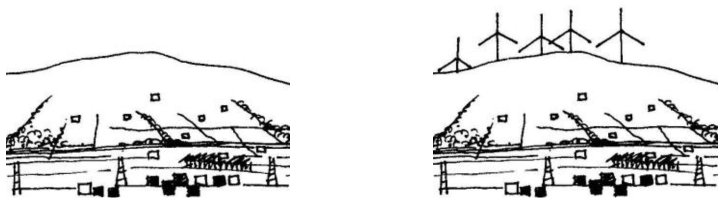
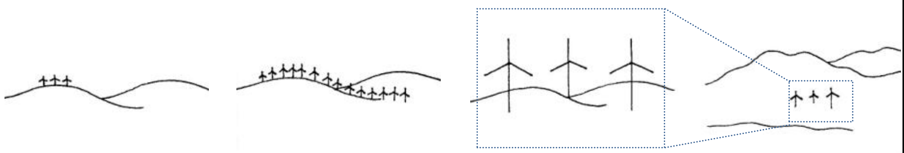
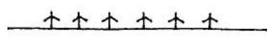
| ***… Pattern of large scale features*** | <br>Figure 5.18: Typical grading of the scale of features between lowland and upland areas in Scotland, with larger scale features located in lowland areas, gradually decreasing in size and density with elevation and/or steepness of slope. A large windfarm upon high ground contrasts to this pattern. |
| **14 Shape and scale of the landform** | Following the published literature, it was not surprising to find that the scale effects of a windfarm related to the scale of the landform upon which it was located. Nonetheless, this is often depicted within guidance as a single, simple relationship whereas, in contrast, it was found on site that landform scale had relevance at different levels depending on the size of the wind turbines and the character of the landform within an area and how this was experienced. In this respect, both the vertical scale of the wind turbines and the collective horizontal scale of a scheme were relevant as illustrated in Figure 5.19 below.<br><br>A scale relationship exists between both the size of the wind turbines and their collective extent in relation to the landform<br>Wind turbines of disparate scale to small hills at a local level may relate to the wider, broad scale landform<br>Figure 5.19: Relationships between windfarm scale and landform scale<br><br>The relative scale of a windfarm upon the landform was found to be most clearly evident where these were seen together from a distance ‘in profile’: ie where the landform feature is viewed from a similar elevation and it appears isolated within a wide open area and/ or against flatter ground or water.<br><br>Although wind turbines within an open and flattish landscape create a clearly contrasting visual image, they were perceived in some circumstances[113] to create a collective vertical edge that<br><br>Figure 5.20: Windfarm creates a collective edge within an open landscape or seascape |

[113] Principally influenced by the height and relative spacing between the wind turbines and their collective extent

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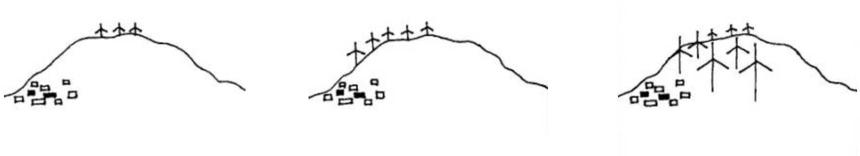
<tr>
<td>… Shape and scale of the landform</td>
<td>
changed the spatial characteristics of the landscape, for example the sense of openness[114].<br>
In contrasting circumstances, where an edge created a landscape feature, such as along the coast or a ridge, a windfarm was found to typically emphasise this edge, depending upon its relative scale and the position of the windfarm in relation to the landform edge.<br><br>
The perceived overbearing effect of a windfarm in relation to a landform feature was found to depend not only on their relative scale, but also other surrounding features that contribute to the setting or backdrop.<br><br>
<br><br>
Windfarm seems to compromise scale of mountain backdrop, particularly as it is not easy to estimate the intervening distance and thus comprehend the degree of visual foreshortening<br><br>
Wind turbines appear minor in scale in relation to mountain backdrop (although they compromise its focal prominence)<br><br>
Figure 5.21: Scale relationships between a windfarm, different landform features and perceived distance<br><br>
The perceived overbearing effect of a windfarm upon a lower adjacent area was found to be greater where wind turbines were seen upon steep hill slopes as well as the landform top, as these appeared visually unbalanced or unstable, as shown in Figure 5.22 below.<br><br>
<br><br>
Windfarm appears visually stable upon landform, not appearing to impose upon the receptors below[115]<br><br>
Windfarms appear visually unbalanced and 'unstable' upon the landform, seeming to be more overbearing in scale upon receptors below<br><br>
Figure 5.22: Perceived overbearing scale effect in relation to position of windfarm upon landform slopes
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[114] Offshore windfarms can result in a similar effect within the open sea, with participants of research carried out Devine-Wright and Howes (2010, p275) reporting they would 'fence in the bay'.
[115] Although there are adverse landscape and visual effects with regards to the landform feature

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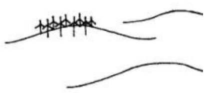
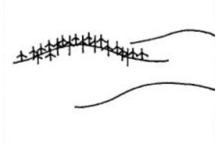
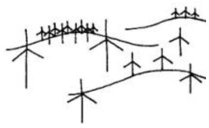
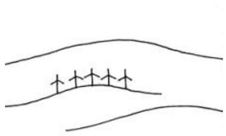
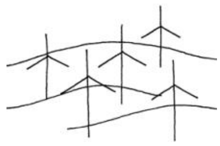
| *... Shape and scale of the landform* | The relationship between windfarm and landform scale was found to be influenced not only by the scale of individual wind turbines or windfarms, but also the collective scale of numerous developments. This was highlighted where a higher number of smaller wind turbines had been ‘repowered’[116] and replaced with fewer, larger wind turbines or where extensions to windfarms had occurred that included the same or different sized wind turbines to an original development. The different spacing between these wind turbines (which tends to be based on the rotor diameter dimension[117]) also resulted in different relationships between the windfarm(s) and the underlying landform, as larger wind turbines often appeared more like separate individuals than a cohesive group.<br><br> Windfarm relates to landform scale and form<br> Extension means windfarm is overbearing upon horizontal scale and shape of landform<br> Mix of wind turbine sizes results in confusion of scale relationship with landform<br><br> Wind turbine size, layout and extent reflects scale of underlying landform<br> Larger wind turbines, wider spacing and/or greater numbers appear overbearing upon the underlying landform scale<br>Figure 5.23: Scale effects of single and numerous windfarms in relation to the landform scale |
| **Windfarm type** | |
| **15 Wind turbine proportion** | Following published literature, it was not surprising to find that the scale effects of wind turbines varied in relation to their overall scale. Nonetheless, it was more unexpected to find that these effects were influenced by their proportions, particularly their blade length (and thus rotor diameter) in relation to their tower height.<br><br>Wind turbines with shorter blades |

[116] ‘Repowering’ typically involves replacing existing wind turbines with machines of higher MW output which are usually larger. This means, if the total MW output of the site is kept the same, the repowered scheme will have fewer turbines. If these have larger rotor diameters, they will usually need to be spaced further apart.
[117] In Scotland, typical spacing is between 4.5 – 6 multiples of the rotor diameter

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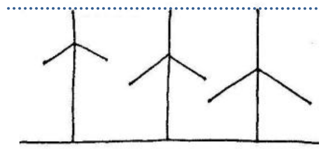
| ***…Wind turbine proportion*** | in relation to their tower height often appeared 'lighter' in form, with emphasis on their vertical dimension. In addition, the turbine blades typically appeared more visually separate from the ground below, so they seemed less directly overbearing upon the underlying landscape. This separation seemed particularly important where the surrounding area was complex in pattern and included human elements.  Figure 5.24: Different form and scale effects of wind turbines that have the same total height, but different proportions<br>In contrast, wind turbines with longer wind turbine blades in relation to their tower height were found to often appear 'heavy' or 'dumpy' in form, with less emphasis on the vertical dimension. In addition, with a closer visual relationship to the ground below, these wind turbines frequently appeared more overbearing upon the underlying landscape.<br><br>Figure 5.25: Differences of visual relationship between wind turbines of different blade length and proportions and the underlying landscape.<br><br>In-between, there were wind turbine proportions that appeared neither obviously top-light or bottom-heavy[118] and appeared far enough above the underlying landscape to appear detached and not overbearing (for further information, Table E.2.1 in Appendix E.2 lists the different proportions of some of the wind turbines assessed). Nonetheless, the relationship between wind turbine proportions and scale effects could not be fully studied within the scope of this research and thus this would benefit from additional research in the future.<br><br>Although total height and proportions tend to be the most obvious scale attributes of wind turbines, the rotor diameter of very large wind turbines was found to have a strong influence on the perceived scale effects when seen face-on[119]. This was because rotation of very long blades created very prominent horizontal and diagonal visual elements within the landscape in addition to the vertical element of the wind turbine tower. Where this occurred, it was found that there was greater focus of attention on the wind turbine blades, rather than the tower or |

[118] Not crossing thresholds of difference of obvious effect, not necessarily representing the ideal solution

[119] ie with all the blades seen facing the viewer because they are viewing in line with the wind direction

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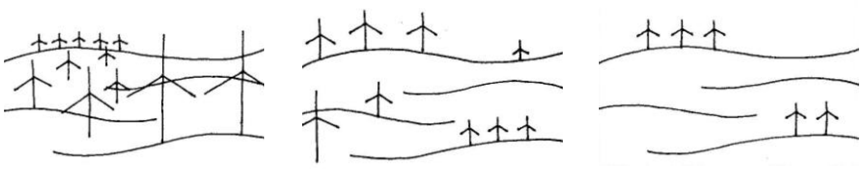
| | nacelle and that, as a consequence, these became the key component from which an estimation of scale was made. |
| **16 Variation of wind turbine size** | Structures that are closer to us tend to appear larger in our view, following the influence of linear perspective (discussed in chapter 2). In addition, following object recognition, we tend to assume that all wind turbines within a scheme[120] are the same size if they appear consistent in form and as one part of a collective group. As a consequence, where wind turbines appear smaller and closer or larger and more distance within our views, this tends to result in a very confusing perception of scale, as shown in Figure 5.26 below.<br><br><br><br>Figure 5.26: Differences of scale effect resulting from different wind turbine sizes at varying distance. Left: wind turbines of consistent height, appearing smaller with added distance. Centre and right: mix of wind turbine sizes confuses perception of distance and thus relative scale.<br><br>By comparing perceived scale and the specification of individual wind turbines, it was found that some differences of scale were barely perceivable. Whilst some practitioners have suggested in the past that this may equate to a small difference of *x* or *y* metres[121], this research found that noticing or recognition of scale difference related more to whether this could be identified as a clear ratio of difference, following Van der Laan's theories on the 'plastic number' (Padovan, 1999)[122].<br><br>As raised by the theoretical background to this research, people's perception of relative scale may be based on reference to what is considered normal[123]. Supporting this and research by Nasar and Stamps (2009), it was found that common use of a certain size or number of wind turbines within a distinct area could establish this as the norm. This effectively created a benchmark of what was 'medium' scale. It also meant that one scale of wind turbine or windfarm might be perceived as being relatively 'small' within one area, but relatively 'large' within another (although, as discussed in chapter 2, reference to a norm is only one way of making scale reference and other methods may apply at the same time). |

[120] this may be within a single development or several separate developments that are 'read' as a single windfarm or windfarm cluster
[121] For example Landscape Institute Scotland, 2016
[122] There was unfortunately not adequate scope within this research to explore further the thresholds for noticing these different proportions which seemed to vary for different landscape contexts and windfarm designs and this would benefit from additional research.
[123] So this judgement may change over time

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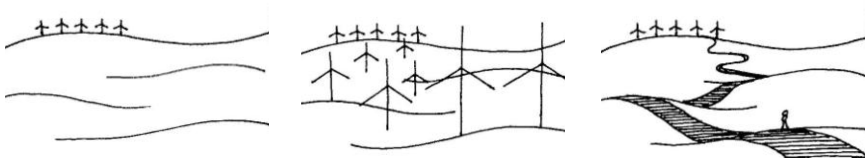
<td>17<br>Extent of windfarm</td>
<td>As distance cues inform perception of scale, it was not surprising to find that multiple wind turbines and/or extensive tracks across an area informed a perception of distance. This was most clear where the cues were at regular intervals, such as snow poles, fence posts or trackside bollards. For similar reasons concerning legibility of cues, the distance and extent of a windfarm was also found to be most obvious from elevated viewpoints.<br><br><br><br>Figure 5.27: Distance cues aid scale estimation. Left: no cues. Middle: cues provided by wind turbines, although ambiguity due to variable spacing and potential size. Right: cue provided by track between viewer and windfarm.<br><br>Following Crowe (1958), the scale effects of a windfarm’s extent was found to relate to the proportion of this in relation to the scale of surrounding open space that also acted as a buffer between the development and surrounding receptors.</td>
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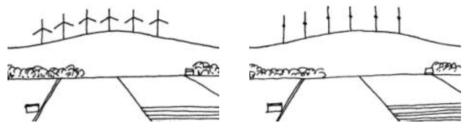
<td>18<br>Wind turbine orientation and lighting</td>
<td>In addition to wind turbine size and proportions, the orientation of wind turbines may influence scale effects, for example whether seen mainly side-on, perpendicular to the wind direction, so the wind turbines appear to have a single vertical form.<br>Although people tend to see a windfarm from many directions as they move through a landscape and thus the relevance of this issue is diminished, there can be static viewpoints from which the typical scale effect is influenced by wind turbines tending to face in the same direction in response to consistent wind conditions.<br><br><br><br>Figure 5.28: Alternative scale effects of wind turbines seen facing different directions<br><br>Another characteristic of wind turbines that may influence perception of scale effects was found to be aeronautical lighting, as the inclusion of these ‘labelled’ the wind turbines as very tall in association with other human-made structures in the landscape[124] that are lit, such as television masts. Nonetheless, these lights tend to be seen mainly at night and thus scale effects are less evident at these times because of a lack of visible context.</td>
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[124] In the UK, there is a requirement for aeronautical lighting on wind turbines of 150m or more or if these pose a particular risk due to their siting in relation to an airfield, radar or flight paths (Civil Aviation Authority, 2010).

## 5.4 LVIA: Summary

This chapter has described the research findings for the LVIA method which applied or analysed LVIA in four different ways. Together, these have provided better understanding of the scope of LVIA to assess scale effects through GLVIA, how LVIA is typically carried out in practice, and how this relates to potential sensitivities to scale effects. The following diagram in Figure 5.29 provides a summary of the findings.

**Key findings that are new, unexpected or that challenge current understanding**

**Review of GLVIA2** to understand scope of LVIA following GLVIA2 to assess scale effects

- Useful **structured approach** and flexibility of GLVIA2 means can support **thorough assessment of scale effects**
- **Confusing uses of word 'scale'**, eg used for both scale of characteristic and magnitude of effect
- Unclear how to judge **the relative importance of various effects** and **the thresholds of effects.** Also some difficulty splitting aspects of scale between the landscape and visual resource.
- Unclear expectations for **consultation to understand how the landscape is experienced**

**Review of existing LVIA reports to understand how these assess and convey scale effects**

- LVIAs typically followed the broad process advised by GLVIA2, but **did not contain sufficient information to convey the scale effects of a windfarm proposal** and how it would be experienced
- LVIAs included many **ambiguous terms or descriptions for scale**, eg not indicating scale references or the meaning of thresholds such as being 'in scale' or 'out of scale'
- Where describing scale, this was mainly **visual scale, not spatial scale**, and did not refer to the different processes and cues for scale perception, nor how scale effects **would influence the experience and value of the landscape by people**

**Site assessment of windfarms to identify sensitivities to scale effects that should be considered by LVIA**

**The range of sensitivities to scale effect that should and could be assessed through LVIA in the future**

- Produce provisional prompt list (Chapter 8 and Appendix H.7)
- Consider GLVIA3 for future applications (Section 8.2)

**18 attribute types identified as sensitivities for scale effects**

Spatial characteristics and experience of the landscape

- Relationship between windfarm and the scale of spaces and people
- Distance, access and vantage points
- Influence of elevation of viewpoint on scale estimation and effects
- Scale of landform edge
- Perceived scale of extent of a landscape

Landscape type

- Varying relationship to landscape characteristics and landscape character type
- Relationship between wind turbines and other vertical features
- Pattern of large scale features
- Shape and scale of the landform

Legibility of the landscape scale and landscape pattern

- Landscape pattern and cues for perceiving distance
- Visual relationship to the landform skyline
- Relationship between windfarms and the scale of woodland and screening by this
- The influence of landscape pattern on scale indication and perception of an overbearing scale effect
- Influence of landform or woodland on the visible scale of wind turbines

Windfarm type

- Wind turbine proportion
- Variation of wind turbine size
- Extent of windfarm
- Wind turbine orientation and lighting

Figure 5.29: LVIA: Diagrammatic summary of key findings

## Chapter 6

# EXPERIENTIAL LANDSCAPE ASSESSMENT: RESEARCH FINDINGS AND INTERPETATION

This chapter describes the research findings and interpretation for the experiential landscape assessment. This method assessed the dynamic experience of the landscape, recognising that this embodied both perception and personal involvement and activity within the landscape.

Experiential landscape assessment was found to be a very useful method for this research in addition to LVIA, particularly in engaging people to reveal what they believed to be the characteristics and qualities of a landscape relevant to scale and how and why they experienced and valued these. The development and establishment of this method took a large amount of work, as it needed to be tailored specifically to the nature of the research questions and the case study participants. In addition, a large amount of time was required to organise and carry out the semi-structured interviews.

It was fairly straightforward to obtain participants for the semi-structured interviews for case studies A and B (areas of existing and proposed windfarms) and participants that were professionals involved in relevant work within case study C (an area with neither an existing or proposed windfarm). Nonetheless, it was much more difficult to obtain members of the public as participants for the semi-structured interviews for case study C, probably because people judged the need for the study to be less urgent or important to them. Although this reluctance did not present a significant problem for this research, it nonetheless highlights a key challenge for public participation in the future for assessment of landscapes for which there is no specific development proposal (discussed further in chapter 8).

Following thorough preparation, the semi-structured interviews ran well and participants engaged willingly with the process and the topic of the research. Fifty-six people took part in the semi-structured interviews within the case study areas, comprising 73% *(n=41)* members of community councils and the public and 27% *(n=15)* landscape or planning professionals. Whilst the numbers of these were limited, a wide range of participants were involved within the three case study areas and provided a wealth of data. Unsurprisingly, some participants found it easier to convey information than others. Nonetheless, for those that found it more challenging, the process was assisted by keeping participant numbers low within the interviews and having the flexibility of the semi-structured format to facilitate communication, such as being able to use images, maps and follow-up prompts that related to participants' specific ways of life. The majority of participants seemed most comfortable with providing data and information verbally in reference to maps or views on site.

When recording discussion and answers by participants, in addition to writing notes that incorporated a degree of review (to focus upon that which was most relevant), the researcher also recorded some participants' responses in their 'own words'. This was to consider not just what the experiential landscape characteristics were, but also how these were described by different people. For example, one resident described the importance of the landscape as being '*an everyday landscape, encountered no different than to brush your teeth'*, whilst a couple described the potential influence of wind turbine scale as: '*They will appear to hover above us. There will be this great presence, even when not actually seen; just over-powering'.*

Feedback from participants of the semi-structured interviews was very positive, with many saying that they had found the process interesting and that it had helped them to think and understand better how they experienced their landscape and its particular qualities and value.

Participants frequently referred to characteristics or qualities of the landscape that had also been identified through the site assessment for the LVIA method. Nonetheless, in comparison with these and the responses and representations to planning applications (described in chapter 1), their descriptions typically provided greater detail and understanding of how the characteristics and qualities were experienced and their relative importance and value to different people. In this respect, there was not significant difference between the responses from the professionals or the public, although there was difference in how these tended to communicate the information and, particularly, the confidence of participants when describing aspects of scale. As mentioned previously in the method chapter 4, just the act of the researcher recording the statements made by participants was noted in feedback from a pilot study as reinforcing the perceived validity of people's descriptions which then encouraged them to provide further material.

Most of the scale effects of existing or proposed windfarms were described by participants as adverse. Nonetheless, even for these schemes, many participants acknowledged that the wind turbines had some positive visual effects and/or proved fascinating to watch. For example, one participant remarked that '*they [the wind turbines] are majestic in some ways'*, whilst another remarked that '... *there is an elegance to them that pylons don't have'*. This highlighted, importantly, that participants could distinguish between scale effects and other landscape and visual effects and between some of these being positive or negative whatever their judgement of the overall acceptability of a windfarm scheme.

Once the data from the semi-structured interviews had been collected, these were combined with the data from the researcher's site assessment, and then analysed and classified. The main reason for combining the data from the semi-structured interviews with those from the site assessment was that these complemented each other and improved understanding of the data from both sources.

Following analysis and categorisation of the data from the experiential landscape assessment, an interim report of findings for each case study was produced which also incorporated the findings of the LVIA stage D. The purpose of this combination and categorisation was to help comprehension of the interim findings by participants, following published literature that highlighted how people recognised better combined characteristics of the landscape rather than individual aspects (for example The Research Box, LUC and Minter, 2009). For the same reason, the interim reports included description of all the landscape and visual characteristics identified by the experiential landscape assessment, not just those concerning scale effects.

Examples of two pages from one of the interim reports are shown overleaf in Figure 6.1, with an example of a complete report included within Appendix F.1. As can be seen from these, the interim findings were presented within the reports within two separate columns: the left-hand column described the key characteristics and qualities of the landscape and how these are experienced, whilst the right-hand column described the sensitivities of the landscape and visual receptors to an existing or proposed windfarm in direct relation to the characteristics and qualities described opposite.

The interim reports were emailed to all the participants (or their representatives for groups) with a request for them to provide feedback if they wished. The responses received typically highlighted details such as place names (often known locally as something different from the OS maps), although some also commented upon the representation of characteristics and the use of the diagrams and photographs within the report. Some people also supported the value of the side-by-side format, which they said helped to make a direct link between the existing baseline and potential landscape and visual effects, and others highlighted how the descriptions helped them to understand the characteristics and qualities of their area. For example, one community council member emailed to say how she felt the researcher's draft description brought a clarity and simplicity to the community's thoughts that '… *makes it fall into place'*. She added: '*I kept thinking "yes, of course that's why we still feel the way we do…" or "that's exactly why xx is a problem yet" or "once Caroline says yy, it crystallizes the whole position… " Thank you so much!! '*.

For case study B, feedback was also received as part of a case report by a Scottish Government Reporter (Scottish Government Directorate for Planning and Environmental Appeals, 2012) after the interim findings were included within evidence submitted by Community Councils for a proposed windfarm. For this, the Reporter stated (p67): '…*based on my accompanied and unaccompanied site inspections, I consider her [the researcher's] analysis more closely reflects how the local landscape is actually perceived and experienced than set out on behalf of the applicants [within a LVIA following GLVIA2].'*

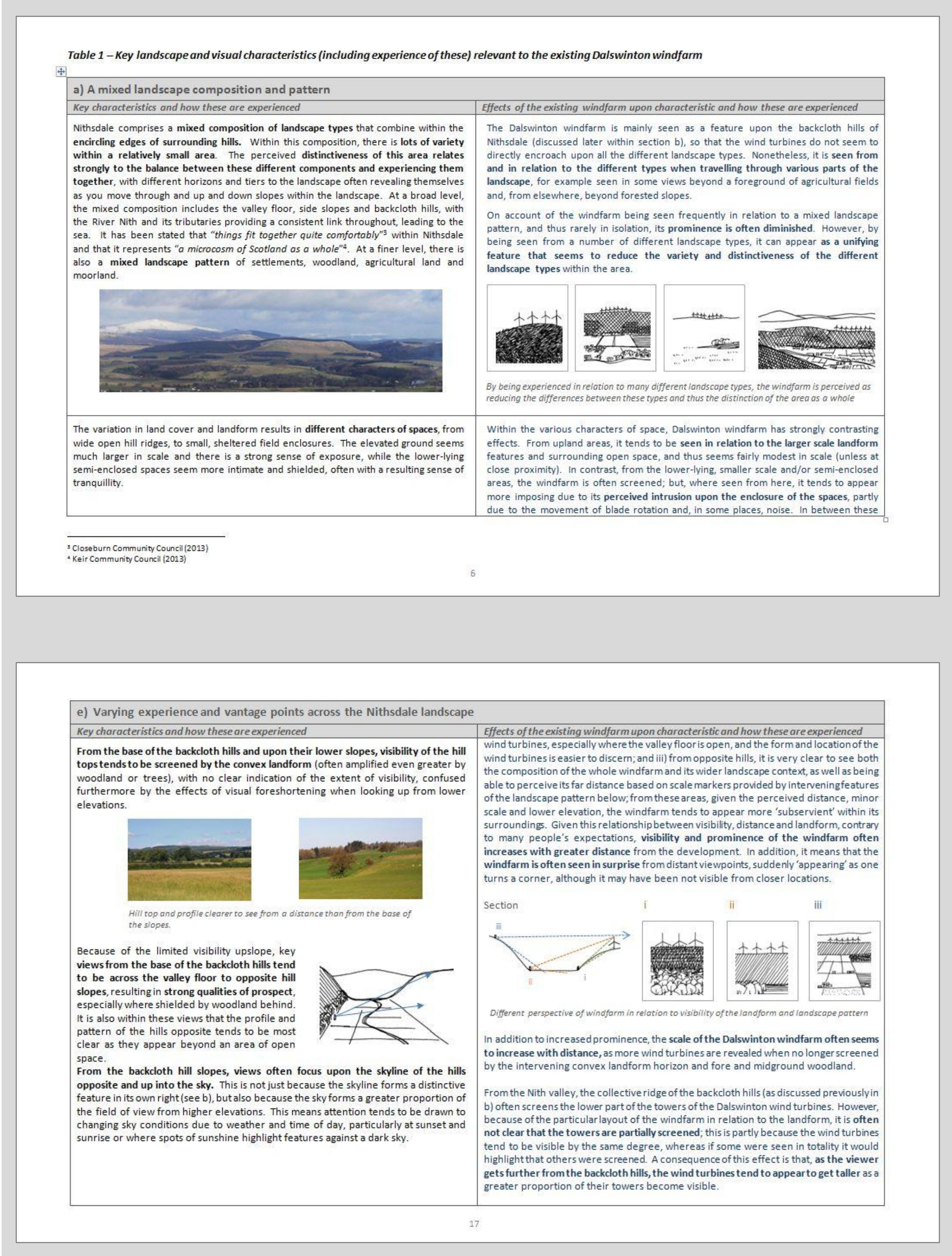
*Table 1 – Key landscape and visual characteristics (including experience of these) relevant to the existing Dalswinton windfarm*

| a) A mixed landscape composition and pattern | |
|---|---|
| *Key characteristics and how these are experienced* | *Effects of the existing windfarm upon characteristic and how these are experienced* |
| Nithsdale comprises a **mixed composition of landscape types** that combine within the **encircling edges of surrounding hills.** Within this composition, there is **lots of variety within a relatively small area**. The perceived **distinctiveness of this area relates strongly to the balance between these different components and experiencing them together**, with different horizons and tiers to the landscape often revealing themselves as you move through and up and down slopes within the landscape. At a broad level, the mixed composition includes the valley floor, side slopes and backcloth hills, with the River Nith and its tributaries providing a consistent link throughout, leading to the sea. It has been stated that *"things fit together quite comfortably"*[3] within Nithsdale and that it represents *"a microcosm of Scotland as a whole"*[4]. At a finer level, there is also a **mixed landscape pattern** of settlements, woodland, agricultural land and moorland. | The Dalswinton windfarm is mainly seen as a feature upon the backcloth hills of Nithsdale (discussed later within section b), so that the wind turbines do not seem to directly encroach upon all the different landscape types. Nonetheless, it is **seen from and in relation to the different types when travelling through various parts of the landscape**, for example seen in some views beyond a foreground of agricultural fields and, from elsewhere, beyond forested slopes.<br>On account of the windfarm being seen frequently in relation to a mixed landscape pattern, and thus rarely in isolation, its **prominence is often diminished**. However, by being seen from a number of different landscape types, it can appear **as a unifying feature that seems to reduce the variety and distinctiveness of the different landscape types** within the area.<br>*By being experienced in relation to many different landscape types, the windfarm is perceived as reducing the differences between these types and thus the distinction of the area as a whole* |
| The variation in land cover and landform results in **different characters of spaces**, from wide open hill ridges, to small, sheltered field enclosures. The elevated ground seems much larger in scale and there is a strong sense of exposure, while the lower-lying semi-enclosed spaces seem more intimate and shielded, often with a resulting sense of tranquillity. | Within the various characters of space, Dalswinton windfarm has strongly contrasting effects. From upland areas, it tends to be **seen in relation to the larger scale landform** features and surrounding open space, and thus seems fairly modest in scale (unless at close proximity). In contrast, from the lower-lying, smaller scale and/or semi-enclosed areas, the windfarm is often screened; but, where seen from here, it tends to appear more imposing due to its **perceived intrusion upon the enclosure of the spaces**, partly due to the movement of blade rotation and, in some places, noise. In between these |

[3] Closeburn Community Council (2013)
[4] Keir Community Council (2013)

6

| e) Varying experience and vantage points across the Nithsdale landscape | |
|---|---|
| *Key characteristics and how these are experienced* | *Effects of the existing windfarm upon characteristic and how these are experienced* |
| **From the base of the backcloth hills and upon their lower slopes, visibility of the hill tops tends to be screened by the convex landform** (often amplified even greater by woodland or trees), with no clear indication of the extent of visibility, confused furthermore by the effects of visual foreshortening when looking up from lower elevations.<br>*Hill top and profile clearer to see from a distance than from the base of the slopes.*<br>Because of the limited visibility upslope, key **views from the base of the backcloth hills tend to be across the valley floor to opposite hill slopes**, resulting in **strong qualities of prospect**, especially where shielded by woodland behind. It is also within these views that the profile and pattern of the hills opposite tends to be most clear as they appear beyond an area of open space.<br>**From the backcloth hill slopes, views often focus upon the skyline of the hills opposite and up into the sky.** This is not just because the skyline forms a distinctive feature in its own right (see b), but also because the sky forms a greater proportion of the field of view from higher elevations. This means attention tends to be drawn to changing sky conditions due to weather and time of day, particularly at sunset and sunrise or where spots of sunshine highlight features against a dark sky. | wind turbines, especially where the valley floor is open, and the form and location of the wind turbines is easier to discern; and iii) from opposite hills, it is very clear to see both the composition of the whole windfarm and its wider landscape context, as well as being able to perceive its far distance based on scale markers provided by intervening features of the landscape pattern below; from these areas, given the perceived distance, minor scale and lower elevation, the windfarm tends to appear more 'subservient' within its surroundings. Given this relationship between visibility, distance and landform, contrary to many people's expectations, **visibility and prominence of the windfarm often increases with greater distance** from the development. In addition, it means that the **windfarm is often seen in surprise** from distant viewpoints, suddenly 'appearing' as one turns a corner, although it may have been not visible from closer locations.<br>Section i ii iii<br>*Different perspective of windfarm in relation to visibility of the landform and landscape pattern*<br>In addition to increased prominence, the **scale of the Dalswinton windfarm often seems to increase with distance,** as more wind turbines are revealed when no longer screened by the intervening convex landform horizon and fore and midground woodland.<br>From the Nith valley, the collective ridge of the backcloth hills (as discussed previously in b) often screens the lower part of the towers of the Dalswinton wind turbines. However, because of the particular layout of the windfarm in relation to the landform, it is **often not clear that the towers are partially screened**; this is partly because the wind turbines tend to be visible by the same degree, whereas if some were seen in totality it would highlight that others were screened. A consequence of this effect is that, **as the viewer gets further from the backcloth hills, the wind turbines tend to appear to get taller** as a greater proportion of their towers become visible. |

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Figure 6.1: Example pages from interim report prepared for each case study area (see Appendix F.1 for example of full report and to read text)

As the interim reports described a wide range of landscape and visual characteristics and qualities, it was necessary to review them after feedback had been received from the case study participants to draw out those aspects concerning perception of scale and scale effects.

## 6.1 Categorised findings of the experiential landscape assessment within the case study areas

The following section describes the findings of the experiential landscape assessment for the three case study areas, structured according to the categories of the assessment criteria.

### *6.1.1 Distribution and relationship between landscape character, settlements, residences and routes from which the landscape is experienced*

A key finding of the experiential landscape assessment, supporting the LVIA and published literature, was that the overall experience of a landscape reflects a composite of different experiences. Within the locality of a windfarm, there has often been focus within LVIA upon specific views from settlements to represent local people's interests. Whilst these are important, participants of this research method conversely highlighted how their experience of the landscape was formed from a much broader and mixed experience of being in different places, on different journeys, whilst carrying out different activities and at different times. This meant that people experienced a windfarm in relation to many different contexts, such as from settlements, roads and residences, as well as from many different landscape character types.

Considering further how people experienced a composite of landscapes, participants described how they judged the scale of one landscape relative to another, supporting the importance of size contrast and scale reference raised in published literature on scale perception. This meant that the scale of a windfarm (as well as other large scale features such as castles) were judged not just in relation to their site and immediate surroundings, but the wider landscape context in which they were viewed, for example as illustrated overleaf in Figure 6.2. In addition, participants frequently mentioned the importance of specific vantage points that were valued for revealing how the different parts of a landscape fitted together, for example where passing over an elevated watershed or hill edge.

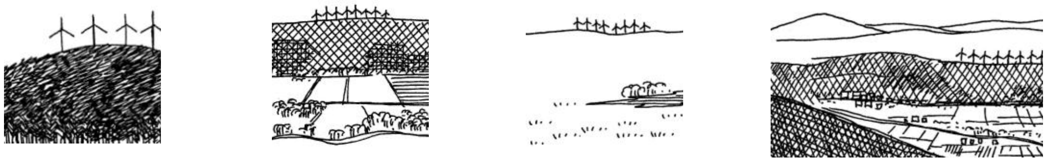


Figure 6.2: Examples of alternative ways in which the scale of the case study A windfarm was viewed in relation to the different scales of the landscape context

The perceived overbearing effect of a windfarm was, not surprisingly, influenced by the perceived scale (horizontal and vertical) and proximity of wind turbines in relation to the people viewing these. Furthermore, this was influenced by the relative elevation of the wind turbine bases and tips above a viewer. Participants of the study made comments such as: '*it [the windfarm] will be so close to settlements. It is the size of the windfarm and the size of the turbines; excessively large'*. In addition, some mentioned that a windfarm would have a '*completely overwhelming presence; completely over-powering'.* Responses of this type were particularly strong for the case study B windfarm due to its very large wind turbines (149.5m to tip) and its siting within a relatively small area of hill ground that had many local roads and residences located at close proximity all around. Participants highlighted how this would mean they would see a windfarm repeatedly during their everyday experience of their local landscape, for example from their homes, whilst driving to local villages or towns, whilst on the 'school run', whilst walking their dogs or whilst working on local crofts. One person commented that a windfarm would be '*so close to settlement; so many will see it'* and another described how the area '*… is a large community. The dispersal of farms, crofts and residences means that there isn't strong distinction between one and the* other; *there are strong connections throughout the area.*' Given that local people would see the windfarm from so many places and during many different activities, a key concern expressed was that local people would not get any respite from the presence of a windfarm. One person stated: '*The windfarm would be an assault on the landscape. It will be disturbing because this assault will affect us all every day'*.

To provide respite from windfarms within an area, participants described three different ways this could be assisted: one, having locations within an area in which they could carry out specific activities (for example a local walk) from which windfarms were not visible or did not have significant adverse effects; two, having areas of each landscape character type from which windfarms were not visible or did not have significant adverse effects; or three, ensuring that the scale effect of windfarms (individually or cumulatively) did not result in people perceiving that they were surrounded by windfarms (not necessarily corresponding directly with the actual geographical distribution of these).

In an area of variable landscape character type, participants described how they went to different areas for different recreational activities, for example visiting the hill tops during periods of clear weather when they were keen to experience open, distant views, and visiting the deep glens and woodland when they were seeking shelter and strong qualities of tranquillity. As a consequence, views of a windfarm from these contrasting areas would diminish the distinction between their characters.

Through the experiential landscape assessment, participants highlighted how the perceived scale of a windfarm affected them and others within the community. Not only did they highlight the effects of seeing a windfarm, but also how a windfarm perceived as too large and/or close to a community could be judged as intrusive on people and place in a way that was perceived as confrontational and distasteful. For example, one person stated '*it is offensive to see wind turbines against residences, whether we know the people in the buildings or not. It is an offence on a community, not just the individual*.' This relates to the theory of Hall (1966) that we often compare imposition of a structure to social rudeness, resulting in similar negative feelings.

### *6.1.2 Activity of people within the landscape*

Most of the participants of the experiential landscape assessment described how they valued their experience of the 'everyday' landscape, with one describing their local area as '*… a living landscape that integrates people within the landscape'* and another that '*it is the backcloth to life'*. They raised journeys as being particularly important for this everyday experience, partly because these offered the opportunity to look around and 'digest' their surroundings and partly because it was during these journeys that they made reference to boundaries to distinct areas and arrival/exit points.

Whilst it might be expected that local people would value what they perceived as their everyday local landscape characteristics (and this is reflected within some planning policies, such as those following the European Landscape Convention), this nonetheless highlighted the high sensitivity of these to scale effects. This supports the findings of other studies carried out on experiential landscape, such as The Research Box, LUC and Minter (2009) and Thwaites and Simkins (2007), but contrasts to some LVIAs that were found to focus upon assessing effects from places judged as being most promoted and popular for visitors. One example of a characteristic that may not appear particularly valuable to people outside an area, but was highlighted as being of high value by participants within all three case study areas (reflecting in part their rural character), were local, single-track roads. Participants described how these quiet roads were used for a range of activities, such as walking to school and to see neighbours (particularly within dispersed settlements) or walking dogs, as well as cycling, horse riding and local access by car. Several participants explained how the everyday experience was important to visitors as well as people who lived and worked in an area, saying these '… *like the integrated character of the landscape - not segregation of tourist services and local services - just an informal mixing.'*

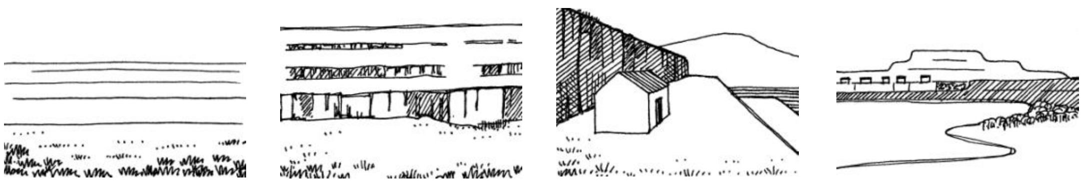
Developers of windfarms have sometimes suggested in the past that people will get 'used to' a windfarm, so that the landscape and visual effects will only be short term and diminish as the structure gradually becomes assimilated within the landscape[125]. With this in mind, it was useful to discuss with participants of case study A how people perceived the effects of the windfarm in their area to have changed over the five years[126] that the existing windfarm had been operational. Consistently, their responses were that, yes, they had grown 'used to' the windfarm in that they were not now startled when they saw it, but they nonetheless thought that the windfarm remained just as prominent as it did after first construction and its landscape and visual effects had not diminished over time. They explained that the main reason for this was that the windfarm looked different every time they saw it; for example, its light and colour varied in relation to the visibility and light conditions and the blades rotated at different speeds or faced different directions. One woman described how the windfarm was the last thing she looked at from her windows at

[125] For example Renewables UK Annual Conference, Manchester, 25-27 October 2011. Discussion during session C7, Onshore development, public perception of turbines in the landscape.
[126] The windfarm was operational first in 2008 and consultation for this research within case study A was carried out in 2013

night and the first thing she looked for in the morning, even though she felt it had negative scale effects. She explained that she still looked for the windfarm, despite her negative feelings, because she found it fascinating: it appearing different every time. The downside of this was that she felt the adverse effects of the windfarm affected her continuously.

### *6.1.3 Visibility, legibility and references within the landscape*

The findings of the experiential landscape assessment supported published literature and the other research methods by confirming the strong influence of processes and cues for scale perception, including object recognition, as people applied previous experiences of scale to judge new situations. Nonetheless, these perceptions and predictions were found to be vulnerable to misinterpretation, for example due to the effects of scale constancy. This was partly responsible for participants describing surprise locations or occasions when they had seen an existing or proposed windfarm (the latter marked by an anemometer) unexpectedly or appearing larger or closer than they predicted. This mainly occurred where the landscape seemed previously more or less extensive than it actually was due to partial screening (for example by vegetation or a convex landform), a lack of distance markers or the unclear influence of visual foreshortening. One participant remarked: '*I have been quite surprised about the places from where you can see them [the wind turbines], and you can see them further than expected'*, whilst another said *'it gives you odd views: unexpected consequences'*. With specific regards to scale, it was found that, although people could typically see the greatest extent of a landscape from high points, the vertical dimension of the landscape and the relationship of large structures to this was clearest from vantage points that were located part-way up (or down) the landform or from distant opposite slopes, for example as illustrated below for case study C.



| Landform scale unclear when looking down landform from top | Landform scale unclear when looking up landform from bottom | Landform scale clearer when looking up and down along contours of landform | Landform scale clearer when looking from a distance, from where can see the vertical form |
|---|---|---|---|

Figure 6.3: Varying visibility and legibility of landform scale

The scale of existing or proposed[127] windfarms was often found to be a surprise to participants when these were observed across moorland or hill landscapes. This was part-expected given the typical difficulty of perceiving scale across these areas in the absence of size or distance cues. Nonetheless, it was found during this stage of the research that unexpected perceptions of scale also related to participants misestimating the extent of these areas when travelling along local access routes. On further examination, it was found that the main reason for this was that moorland and mountain areas were often circumvented by roads or pathways (due to the difficulty of terrain or drainage across these areas) and thus participants' perception of their extent were often based on how long it took them to get from one side to another around the edge of the area, rather than direct distance cues. Thus the difference between actual and perceived extent was often high and amplified even more where surrounding roads were winding and/or single track and thus travel times longer. A consequence of this misestimating was that the siting of a windfarm within these areas typically resulted in the extent of the area suddenly seeming much smaller (which diminished its value if perceived large extent was a specific quality) and/or the windfarm seemed much larger and/or closer than predicted.

Siting wind turbines so that they are seen in their entirety has long been recommended in good practice guidance[128], usually to aid object recognition and simplicity of visual image. This was supported by the findings of this experiential landscape assessment, with participants highlighting how partial visibility caused concern due to a lack of clarity. One person said: '*Size does matter and I like to see the whole turbine*', whilst another stated '*it is a bizarre thing: blades popping up over the skyline*'.

Although it is difficult to relate the scale of windfarms directly to other built elements in the landscape due to their disparity of scale, it was found that participants judged the incongruity or compatibility of a windfarm's scale in reference to the location of other large elements within a landscape. This meant that participants found the scale of windfarms upon hill tops to contrast to the typical concentration of large scale structures within lowland areas (as also found for the LVIA method, described in Table 5.2), with some

[127] As illustrated by computer-generated wireline diagrams for proposed developments
[128] For example SNH, 2014a.

participants highlighting how this changed their value of the experience of hilltops. For example, one person stated that seeing large scale wind turbines upon the hills appeared incongruous because '*…if you are elevated, you expect everything to get tiny and appear small scale'.* Another incongruity of scale highlighted by participants was the scale relationship between wind turbines in elevated locations and the perceived importance of historic features such as castles or hill-top forts. If a windfarm was larger in scale than these features and/or elevated higher than them, it was perceived to diminish the qualities of the historic feature in terms of its defensive position and outlook, as shown in Figure 6.4 below.

The perceived historic defensive qualities of the castle are derived in part from its greater elevation and imposing scale overlooking the landscape below

Windfarm seems to diminish perceived historic defensive qualities of the castle by appearing much larger in scale and more elevated

Figure 6.4: Relationship between windfarm scale and perceived qualities of historic features

Large scale structures in the landscape, especially where located upon high and/or open ground, will tend to create foci or landmarks. This had been acknowledged within some of the LVIA reports reviewed for this research in terms of the prominence of a proposed windfarm. Nonetheless, during this method of the research, participants also highlighted how large windfarms could divert attention from small scale characteristics of the landscape (with which many participants felt 'comfortable' and thus valued), shifting emphasis to the broader scale composition of the landscape that related more closely to the windfarm's scale. In this way, participants described how a large windfarm could change the reference points within an area which were important to them and helped them make sense of their surroundings (supporting Lynch, 1960; and Ward Thompson, 2013). For example, they described how a windfarm overshadowed previous small scale reference points, such as a village memorial, changing people's mental map of their surroundings. One participant remarked: '*The road junction to my house used to be described as next to the bridge, but now it is described [by other people] as next to the windfarm. It changes the sense of your place in the landscape'*.

Numerous windfarms have cumulative landscape and visual effects. Although these effects are described within existing good practice guidance as being influenced by the compatibility of the scale of windfarms within a distinct area or landscape character type, participants of this method of the research were typically more concerned about their collective extent and how multiple schemes may seem to surround them[129]. This issue was considered by some of the LVIAs reviewed by this research, but usually only with regards to the visible extent of numerous schemes seen from specific elevated viewpoints. Conversely, participants of this research described more frequently how they perceived the cumulative effect of being surrounded via the journeys they took through the landscape. This was partly because they frequently encountered several windfarms sequentially, one after the other. Participants described how this gave them a mental map of the windfarms within an area (even if this did not correspond directly to the actual geographical locations). For example, this meant that windfarms located close to each other that were difficult to view resulted in less perceived overbearing effect by encircling compared to others that were further apart but easy to see together or one after the other along key routes through the landscape. Participants also highlighted the sensitivity of viewing windfarms along upland long distance walks or rides, where movement through the landscape is slow, meaning people view numerous windfarms over long durations.

### 6.1.4 Spatial characteristics and the experience of these

Supporting the findings of the LVIA, the experiential landscape assessment revealed that people's judgement of scale was influenced strongly by the spatial characteristics of the landscape and perceived separation between spaces. With regards to the latter, participants highlighted the difference between spaces that they perceived to be 'here' or 'there', which influenced whether a windfarm was perceived to directly affect 'their space' or another. More unexpected was that participants also highlighted that, if a windfarm was seen within a separate space to the viewer, the perception of scale effects were influenced by the characteristics of both the space in which they were located as well as the one in which they could see the windfarm. This meant, for example, that although the scale effects of a windfarm within moorland would be influenced by the openness of its

[129] This was influenced by the fact that, at the time of this stage of the research within the case study areas, the compatibility of the scale of numerous windfarms was not an obvious issue as existing windfarms within these areas were widely separated

immediate surroundings, its scale effects may also be influenced by a viewer's location within an adjacent semi-enclosed agricultural landscape or an intricate coast.

Through participants' descriptions of the different sensitivities to scale between where a windfarm was located to where it was viewed, it was revealed that participants' scale references also varied in relation to differing proximity to a windfarm and the field of view. Where close by and/or within a restricted field of view, perception of an overbearing effect tended to be judged solely and directly in relation to the effect upon them as the viewer; whilst, conversely, at further distances and within a wide field of view, perception of an overbearing effect was more commonly judged in relation to the visual and spatial landscape context.

Upland and moorland landscapes were found to be valued by many participants within the case study areas for their perceived openness and vastness of scale (irrespective of their actual dimensions)[130], supporting previous findings by The Research Box, LUC and Minter (2009). Some participants reported that they visited moorland areas specifically for their open visibility and sense of exposure, with many describing the typical experience of moving through these landscapes by walking, cycling or driving, rather than targeting a specific destination or vantage point. Whilst these landscapes can typically accommodate a windfarm without these seeming incongruous in visual scale, many participants described how they felt a windfarm in these locations was overbearing in spatial scale and perceived proximity. Similar to the findings of the LVIA, a key reason for this was that there was nothing separating the viewer spatially from the windfarm and it was typically difficult to be sure how far away it was; thus it was not possible for someone to reassure themselves that they were distant or separate from the windfarm.

Within upland landscapes, a quality described by many participants in all three case studies was the experience of being elevated above the surrounding land or seascape, especially if great effort, time or distance has been taken to ascend a landscape feature. This perceived quality was described by participants as feeling like you were 'on top of the world' and supports the findings of previous research on experiential qualities. It relates to the elevation of a location compared to its surroundings, not necessarily its actual elevation

[130] Even though, for some participants, this openness reflected diminished habitat value

AOD[131]: a reason why it was described as being experienced upon some relatively small hills or ridges where surrounded by low ground or water. One person described the value to them of this experience with the statement: '*These are my hills and they are precious to me. It must be a case of being near to heaven'*. In relation to this quality and its value to people, the scale effects of a windfarm were found to be strongly influenced by its relative elevation (both the bases and the tips of the wind turbines) and extent, with a stronger sense of being overbearing where seen at a similar or higher elevation to the viewer, as illustrated below by Figure 6.5.

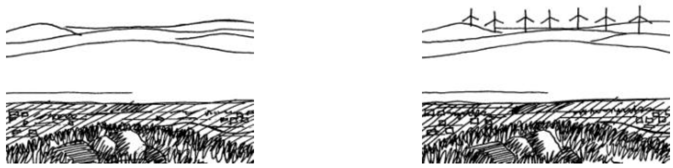


Figure 6.5: The perceived qualities of being elevated and feeling 'on top of the world' diminished by a windfarm located at similar elevation to a viewer upon a high point within the landscape

In addition to a windfarm appearing overbearing when seen as the highest feature within a landscape, participants of the experiential landscape assessment highlighted that they felt wind turbines seemed more overbearing where sited at a higher elevation than them as viewers, supporting the findings of the LVIA. One participant stressed '*people don't like large structures above them; they are threatening.'*

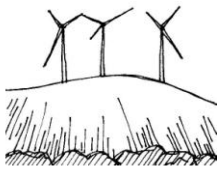


Figure 6.6: Sense of imposition resulting from close proximity and elevated position of windfarm

Prior expectations were raised by participants as influencing their experience of scale effects. This meant that the scale effects of windfarms were strongly affected by where people expected to see them in relation to their function and visibility conditions. For example, participants remarked that, if they were in an open and elevated location such as upon a hill top, they would not be surprised to see a windfarm in the far distance. Conversely, they said that, if they were in a semi-enclosed glen, they would expect to be screened or shielded from seeing windfarms within adjacent areas and thus, if one of these could be seen (even if partially), it would seem more overbearing. One respondent

131 Above Ordnance Datum

described how proposed large wind turbines would be '*oppressive'* within an area they described as having '*intimacy of scale'*.

Hills and ridges adjacent to low areas had been identified previously through the LVIA research to create distinct edges that influenced the perceived scale of a landscape. In addition, participants of the experiential landscape assessment revealed that these hill edges were highly valued, even where the hills were not particularly remarkable in character or appearance. This was principally because the hills provided a constant backdrop to local places and everyday activities. Whilst some liked to ascend the hills for recreation, others described valuing them just for being there and forming a shielding edge. As a direct consequence of these qualities, many participants described how the hills were very sensitive to the scale effects of a windfarm, especially in terms of these seeming to breach or encroach upon their edge and because many of the hills that were perceived and valued for being large were actually relatively small in dimensions. One participant felt so strongly about the hills behind her house that she said '*our hills are practically sacred to us'*, whilst another referred to '*the hills before us, behind us'* having '*an important presence'*.

Wind turbines may appear small in relation to the wide expanse of an adjacent open loch or sea. Nonetheless, it was found that this scale relationship is less straightforward if the seascape is subdivided by peninsulas or islands, or if a windfarm is seen from inland locations where the open water cannot be seen clearly (for example when viewed at a similar elevation and screened by surrounding low slopes). Furthermore, participants highlighted within the experiential landscape assessment (particularly for case study C) how the scale of an inland windfarm may be experienced from adjacent expanses of water or sea, from where vertical features tend to be particularly prominent as landmarks in contrast to the horizontal emphasis of views. Given it is difficult to perceive distance over open water, the scale effects of wind turbines viewed across water were found to be more strongly influenced by their visual scale in relation to other visual features such as cliffs or a backdrop hill, rather than in relation to spatial characteristics or perceived distance, as shown in Figure 6.7 overleaf.

Perceived windfarm scale effect strongly influenced by spatial scale and distance cues

Perceived windfarm scale effect strongly influenced by visual scale and vertical cues in strong contrast to the horizontal fore and midground

Figure 6.7: Varying influence of scale across water or land

People often seek order within a view, relating to a desire for a clear rationale for what they see. Whilst this has in the past led to design guidelines for windfarms advocating a clear layout of wind turbines in direct relation to the landscape characteristics, this research also found that this led to participants preferring a windfarm to be situated within a distinct area or section of the landscape. This seemed to be so they could perceive the relative scale and distance of the windfarm, by 'placing' it within its landscape context, as illustrated within Figure 6.8 below.

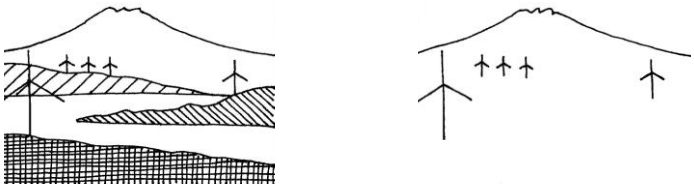


Figure 6.8: Differences of scale effect when wind turbines are seen located within distinct sections or tiers of the landscape composition

## 6.2 Experiential landscape assessment: Summary

This chapter has described the research findings for the experiential landscape assessment. These reveal what characteristics and qualities were important to people within the case study areas with regards to scale, and how and why people experienced and valued these in different ways. Not surprisingly, there was found to be overlap between the findings of the experiential landscape assessment and LVIA methods. Nonetheless, key differences were also revealed, principally due to experiential landscape assessment being focused upon the dynamic relationship between people and the landscape.

The findings of the experiential landscape assessment in comparison and combination with the other research methods are discussed further at the end of this Section C as well as in chapter 8 with regards to how they may be interpreted to inform future assessment and communication of scale effects.

The following diagram in Figure 6.9 provides a summary of the findings.

## Key findings that are new, unexpected or that challenge current understanding

Method

Experiential landscape assessment semi-structured interviews in addition to professional assessment provided **better understanding of how people experience the landscape, what is important to them and why**

**Professionals and the public** in an area describe many of the same aspects, but convey these in different ways, together leading to more in-depth understanding

It is hard to **attract the public to consult** if there is no specific development

Who is affected and people's sense of place

People can distinguish between scale effects upon them **personally and on the community** (communities of place and interest)

**Vantage points** are valued that overlook the landscape and aid legibility, eg upon a watershed or hill top

**Reference points/ landmarks** are very important to people, helping them to 'place' themselves and other elements and thus inform scale and distance perception. A windfarm may change this framework, distracting from smaller scale and less prominent reference points.

People value greatly **hills and horizons** within a local area (even if unremarkable visually or in character), both as an edge and backdrop to a place and activities.

People enjoy **different recreational activities** in different places and at different times and in different weather.

The experience of **feeling 'on top of the world'** is valued greatly. This relies on being higher than surrounding elements, including wind turbines.

Structures perceived to be too close and overbearing are perceived by some people as **confrontational or 'rude'**, imposing upon their 'personal space'

How scale is perceived and experienced

Overall experience of a landscape is a **composite**, reflecting experiences in different places, whilst carrying out different activities and at different times, eg from roads and residences and from different landscape character types. Within this context, people judge the scale of one feature or place in combination and relation to others.

**Journeys** are very important for perceiving scale in a landscape (more than static viewpoints in some areas)

At close proximity, people tend to **judge scale in direct relation** to themselves, but at further distance in relation to the wider landscape context

People's perception of an overbearing scale effect is based upon the **spatial characteristics** around both the viewer and the structure, which may differ.

People's perception of an overbearing scale effect is influenced by **expectations**, eg with high effect in a deep glen from which a windfarm would not be expected to be seen.

People find it **difficult to perceive distance across simple landscapes**, eg moorland, hills or water. Thus this is sometimes informed by travelling around these (leading to a perception they may be larger than their actual size)

Importance of the everyday

The **everyday landscape experience** is very important for residents and those working within a landscape

**Everyday recreation is valued and mainly low-key**, eg walking along local, single-track roads and paths, although **occasional activities** may also be important such as hillwalking or cycling

Windfarms **change constantly, every day**, meaning they are interesting, but always attract attention so that respite is desired by some

Figure 6.9: Experiential landscape assessment: Diagrammatic summary of key findings

# Chapter 7

# PUBLIC ATTITUDE AND PREFERENCE STUDY: RESEARCH FINDINGS AND INTERPRETATION

This chapter describes the research findings and interpretation for the public attitude and preference study. This research method included two different questionnaires: the first examined the words people use to describe scale effects and the second identified the relative importance of different attributes to people's perception of scale effect through application of Adaptive Choice-Based Conjoint (ACBC) analysis.

## 7.1 The words people use to describe scale effects

This section describes the findings of the public attitude and preference questionnaire to ascertain which words were used most consistently and in the most discriminating way to describe different scale effects. At the outset of this research, it had not been expected that this study would be required, but it became increasingly apparent during the research that a problem may exist with different people using the same words to describe different scale effects and using different words to describe the same scale effects. The method for the questionnaire is described within chapter 4, including how this was developed and the use of pilot studies, with further details provided in Appendix D.5. A copy of the questionnaire (circulated to participants on paper) is also included within Appendix D.7.

The questionnaire included nine photographs that showed three different scale effects of windfarms. These were categorised by the researcher as low, medium and high, although this was not indicated within the questionnaire, so that the focus of the participant was on naming the effect, not matching it to a particular category. The terms offered to describe these effects were:

- High effect: overbearing, dominating, imposing
- Medium effect: balanced, modest, influential
- Low effect: unassuming, fitting, unobtrusive

Additionally, participants were advised to add and use their own word if they preferred and to note this down. They were also encouraged to add any comments that they had on the use of these terms or issues of scale effect raised by the questionnaire.

### *7.1.1 Questionnaire returns and respondent characteristics*

The numbers and distribution of the questionnaires and returns are summarised in Table 7.1 below.

| Table 7.1: Distribution and returns of questionnaire on the use of words to describe scale effect | | | | | | | |
|---|---|---|---|---|---|---|---|
| Location/ type of participant | *Number of questionnaires* | | | | | | |
| | *Case study A (Dalswinton): Area of existing windfarm* | | *Case study B (Druim Ba): Area of proposed windfarm* | | *Case study C (North Mull): Area of no existing or proposed windfarms* | | *Total returns* |
| | *Distribution* | *Returns* | *Distribution* | *Returns* | *Distribution* | *Returns* | |
| Rural residences from which windfarm likely to be/ is seen | 15 | 5 | 15 | 5 | 15 | 5 | **15** |
| Rural residences from which windfarm likely not to be/ is not seen | 15 | 8 | 15 | 10 | 15 | 3 | **21** |
| Urban residence of nearby city/town | 15 | 5 | 15 | 5 | 15 | 7 | **17** |
| Professionals whose work covers windfarms & geographical area | 10 | 7 | 10 | 7 | 10 | 8 | **22** |
| **Total** | **55** | **25** | **55** | **27** | **55** | **23** | **75** |

As can be seen from the data in Table 7.1 above, 75 questionnaires were completed and returned (of total *n=165*), with similar numbers for each of the three case study areas.

The main purpose for including demographic questions within the questionnaire (as described in the method chapter 4) had been to ensure that the returns were not strongly biased for one type of respondent. The following section summarises the data from these demographic questions. Generally, these were not unexpected given the method of sampling was not fully randomised and because of the demands of the questionnaire, particularly that it was more likely to be completed by people with an interest in the environment or research, able to comprehend issues of perception and scale, and/or to have sufficient spare time to complete the survey.

Figure 7.1 below shows that there was a fairly even distribution of responses between the different location and type of participant. The only category showing a slighter greater difference between the numbers of responses from case studies is for rural residences from which a windfarm is not seen or would not be likely to be seen.

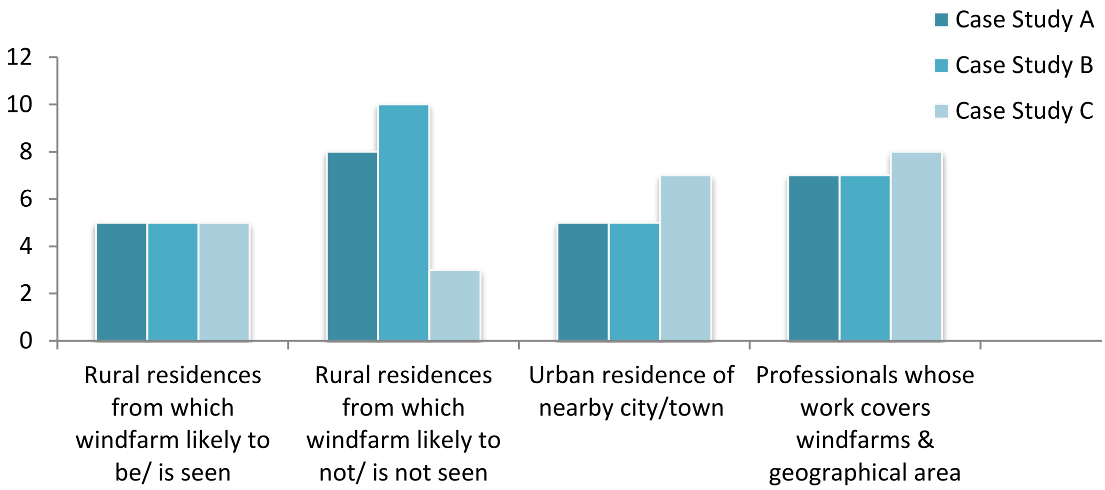



Figure 7.1: Distribution of responses for different locations and types of participant

For the age of respondents, the data revealed that most fell within the three older age groups, 31-45, 46-60 and >60 (97%), with none from the <15 age group and only 2 respondents from the 16-30 age group (further details provided within Table G.1.1 of Appendix G.1).

The occupations of respondents were categorised into two: those likely to be informed about the landscape and the effects of windfarm scale; and those who were not likely to be informed or it was unclear how informed they were about the landscape and the effects of windfarm scale (for example including people that marked their occupation as retired or in administration). The proportion of respondents falling into the first category, the informed group, was 66.22%, leaving the proportion falling into the second category as 33.78% (shown in Table G.1.2 of Appendix G.1). This showed a majority of respondents were likely to be informed about the landscape and windfarms which, as mentioned previously, was not a surprise given the nature of the questionnaire and the type of person likely to respond.

Respondents' attitudes to windfarms were categorised into three: those mostly positive towards windfarms (options 1 and 3 from the questionnaire); those mostly negative towards windfarms (options 2 and 5 from the questionnaire); and those whose attitude depended on the location and siting of the windfarm (options 4 and 6 of the questionnaire). Respondents that selected the 'other' option (8) and provided further information were included within the three categories described above depending on the nature of their response. No respondents selected the 'not sure' option. The respondent data revealed that the highest number of selections (45%) was for an attitude that was qualified by depending upon the location and siting of a windfarm. For the remaining two categories, there were more responses from people that were negative in attitude (30.2%) than positive (24.8%). Nonetheless, this is likely to be influenced in part by the age range of respondents, as 43% were over 60 years in age and non-parametric tests found a positive correlation between increased age and a more negative attitude (*correlation coefficient of .346*, *significance (2-tailed) p=.003, n=74*), which supported published literature. Table G.1.4 of Appendix G.1 shows the responses for these categories.

The questionnaire also asked participants how many windfarms they had seen in the previous five years as the findings of past research were variable with regards to how attitudes and preferences to windfarms varied with familiarity of these (described within section 2.7). The responses to the questionnaire showed that most people were familiar with windfarms, with 88% (*n=66*) having seen six or more and, within this figure, 55% of all respondents (*n=41*) having seen more than 15 windfarms in the previous 5 years.

#### 7.1.1.1 Representation of respondents

To judge how representative the questionnaire respondents were in relation to the general Scottish population, the age and occupation of the questionnaire respondents were analysed in relation to the most recent census which was carried out in 2011 (National Records of Scotland, 2015). This comparison found that more people that were older responded to the research questionnaire than are represented within the general Scottish population, 35% of the questionnaire respondents being within the age group 46-60 years compared to 25% of the general population. In addition, 43% of the questionnaire respondents were within the age group of over 60 years compared to 27% of the general population (further details in Table G.1.1 of Appendix G.1). This is likely to reflect the particular interest and requirements of the questionnaire as well as a high proportion (87.5%) of the professionals that completed the questionnaire being within the older age groups over 46 years.

The 2011 census records occupation within 90 categories. It was not straightforward to align these directly with the occupation categories included within the research questionnaire which were grouped in terms of the likelihood or not of respondents being informed about the landscape and effects of windfarm scale. This was because many of the census categories were ambiguous and/or would include people likely to in both groups, for example categories such as 'other skilled trades', 'public services and other associate professions' and 'Government and related organisations'. Thus a precautionary approach had to be taken when grouping the census data to align with the categorisation of the questionnaire respondents for occupation. This resulted in 10.47% of the general population of Scotland being labelled as likely to be informed about the landscape and the effects of windfarm scale, compared to 66.22% of the questionnaire respondents. In addition, 89.53% of Scotland's population could be identified as likely to be not informed or it was unclear how informed they were about the landscape and the effects of windfarm scale, compared to 33.78% of the questionnaire respondents. Based on this data, it is suggested that the questionnaire respondents were likely to have been more informed through their occupation about the landscape and effects of windfarm scale than is generally the case for the Scottish population.

There are many limitations to the findings of past research studies regarding people's attitudes to windfarms (as discussed previously within section 2.7), which means it was not possible to directly compare the data from these studies with that for the respondents of this questionnaire. In addition, there was no national database available for the number of windfarms seen by people that could be compared to the respondents for this research.

In conclusion, the demographic characteristics of the questionnaire respondents showed reasonable diversity which suggested the questionnaire data were adequate for the purposes of this research. Nonetheless, there was an over-representation of older people compared to the census profile for the general population, as well as a likely over-representation of those knowledgeable about the landscape and effects of windfarm scale. Furthermore, the degree by which the respondents were representative of different attitudes to windfarms and had familiarity of these compared to the general population could not be established. This means that the questionnaire findings cannot be taken as representative of the general Scottish population.

### *7.1.2 Analysis of the responses selecting different words for different scale effects*

The data from the questionnaire responses were collected and analysed in relation to the research questions. These are presented in Tables 7.2, 7.3, 7.4 and 7.5 overleaf and are discussed within the following section. Analysis of the data generally proceeded well, but it became apparent from review of the completed questionnaires that some respondents had been a bit unsure about applying the Likert scale. This was not completely unexpected, as it had been raised previously as an issue within feedback from the pilot studies and, in response to this, the labelling of the Likert scale had been changed, and it was hoped this would address the problem. Unfortunately, conversely, some respondents still seemed to confuse 'weak' scores of 1 or 2 that should represent the suitability of a word to describe the scale effect shown with a judgement of whether the windfarm had a low scale effect. For this reason, it was decided that the different ratings on the Likert scale may be unreliable and thus should not be used for the data analyses and, instead, this should be based on just whether a word was chosen or not. A further complication this raised was that the word selections that had been scored with a 'weak' 1 or 2, if scored correctly, had been judged as a word that represented poorly the scale effect shown and had not been selected positively. After careful consideration of this, it was decided that only respondents' selections of words with a 'positive' 3 to 5 score on the Likert scale should be included in the data analyses.

| Table 7.2: Respondent choices for all case studies* | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Low scale effect image | | | Medium scale effect image | | | High scale effect image | | | Total use of word | |
| | | image 1 | image 4 | image 8 | image 6 | image 3 | image 7 | image 2 | image 5 | image 9 | | |
| Low | unobtrusive | 6 | 4 | 1 | 4 | 3 | 9 | 0 | 0 | 2 | 29 | 132 |
| | unassuming | 5 | 10 | 4 | 4 | 2 | 4 | 4 | 2 | 3 | 38 | |
| | Modest | 13 | 17 | 9 | 6 | 5 | 6 | 4 | 2 | 3 | 65 | |
| Medium | Fitting | 19 | 16 | 7 | 11 | 13 | 18 | 7 | 9 | 6 | 106 | 367 |
| | Influential | 9 | 13 | 12 | 19 | 12 | 17 | 19 | 13 | 9 | 123 | |
| | Balanced | 30 | 9 | 17 | 20 | 19 | 19 | 8 | 6 | 10 | 138 | |
| High | Imposing | 6 | 15 | 19 | 12 | 18 | 14 | 30 | 18 | 25 | 157 | 547 |
| | Overbearing | 6 | 11 | 11 | 14 | 12 | 5 | 21 | 47 | 31 | 158 | |
| | Dominating | 10 | 16 | 27 | 26 | 27 | 11 | 31 | 41 | 43 | 232 | |

| Table 7.3: Respondent choices for all case studies: Percentage of total choices for each word* | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Low scale effect image | | | Medium scale effect image | | | High scale effect image | | | Total % |
| | | Image 1 (%) | Image 4 (%) | Image 8 (%) | Image 6 (%) | Image 3 (%) | Image 7 (%) | Image 2 (%) | Image 5 (%) | Image 9 (%) | |
| Low | unobtrusive | 21 | 14 | 3 | 14 | 10 | 31 | 0 | 0 | 7 | 100 |
| | unassuming | 13 | 26 | 11 | 11 | 5 | 11 | 11 | 5 | 8 | 100 |
| | Modest | 20 | 26 | 14 | 9 | 8 | 9 | 6 | 3 | 5 | 100 |
| Medium | Fitting | 18 | 15 | 7 | 10 | 12 | 17 | 7 | 8 | 6 | 100 |
| | Influential | 7 | 11 | 10 | 15 | 10 | 14 | 15 | 11 | 7 | 100 |
| | Balanced | 22 | 7 | 12 | 14 | 14 | 14 | 6 | 4 | 7 | 100 |
| High | Imposing | 4 | 10 | 12 | 8 | 11 | 9 | 19 | 11 | 16 | 100 |
| | Overbearing | 4 | 7 | 7 | 9 | 8 | 3 | 13 | 30 | 20 | 100 |
| | Dominating | 4 | 7 | 12 | 11 | 12 | 5 | 13 | 18 | 19 | 100 |

**Numbers shown in red represent the three highest scores for each word*

| Table 7.4: Respondent choices for image categories: Percentage of total choices for each word* | | | | |
|---|---|---|---|---|
| | | Low scale effect image (%) | Medium scale effect image (%) | High scale effect image (%) |
| Low | unobtrusive | 37.9 | 55.2 | 6.9 |
| | unassuming | 50.0 | 26.3 | 23.7 |
| | Modest | 60.0 | 26.2 | 13.8 |
| Medium | Fitting | 39.6 | 39.6 | 20.8 |
| | Influential | 27.6 | 39.0 | 33.3 |
| | Balanced | 40.6 | 42.0 | 17.4 |
| High | Imposing | 25.5 | 28.0 | 46.5 |
| | Overbearing | 17.7 | 19.6 | 62.7 |
| | Dominating | 22.8 | 27.6 | 49.6 |

| Table 7.5:Respondent choices for image and word categories | | | |
|---|---|---|---|
| Totals | Low scale effect image | Medium scale effect image | High scale effect image |
| Low effect word | 69 | 43 | 20 |
| Medium effect word | 132 | 148 | 87 |
| High effect word | 121 | 139 | 287 |

#### 7.1.2.1 Words chosen most commonly and in the most discriminating way to describe scale effects

The data shown in Table 7.2 reveal that the terms to describe scale effect used most frequently were those for a high effect (*n=547*), followed by those for medium effect (*n=367*) and those for low effect (*n=132*). This supports earlier findings during development of the method (described in section 4.3.1) which was that people seemed to prefer to describe different levels of high scale effect.

If respondents to the questionnaire preferred to use their own word to describe the scale effect shown, they were asked to write this down on the questionnaire. Sixty three suggestions were made in total (listed in Table G.1.5 of Appendix G.1). Most of these were selected just once (*n=46*), with 12 others selected twice or three times (*n=6* for each) which are small numbers given the 75 respondents each had 3 opportunities[132] to select a particular word for a particular level of scale effect. There were five terms that were selected by respondents between 4 and 8 times in total: ‘blot on the landscape’ (*n=4*); ‘acceptable’ (*n=5*); ‘intrusive’ (*n=5* ); ‘prominent’ (*n=7*); and ‘inappropriate’ (*n=8*). Of these ‘blot on the landscape’ and ‘prominent’ do not specifically describe scale effect; neither do ‘acceptable’ nor ‘inappropriate’, which instead describe judged acceptability of the

[132] Based on 3 of the 9 images showing low, medium or high scale effect.

windfarm.  The only word that does describe scale effect is intrusive (*n=5*) and this had been considered previously for inclusion in the questionnaire, but had been discounted for its similar meaning and use as 'imposing' that was included.  Following this analysis, it was concluded that respondents did not suggest any words for scale effects that were more suitable or popular than those provided by the questionnaire.

Some of the respondents provided additional comments on scale effect following the prompt provided in the questionnaire.  These comments varied greatly in their nature, but mainly added further information on experiential considerations, what elements were informing people's perception and their judgement of acceptability.  For example: '*hazard if seen from road and appalling if seen from house and ruins view for tourists'* [133] and '*even though it is only one, it seems to dominate, possibly due to its scale as compared to the trees'*[134].  The comments were reviewed to inform further development of the public attitude and preference study as well as interpretation of the research findings.

The three highest frequencies for selection of each word option are highlighted in red in Table 7.2 (with some chosen in equal number).  This highlights graphically how there was not a direct relationship between the words selected and the levels of effect shown by each image as, if there had been, the numbers highlighted red would be in the top left 3x3 section (representing both words and images for low effect), the middle 3x3 section (representing both words and images for medium effect), and the bottom right 3x3 section (representing both words and images for high effect).  Nonetheless, when all the selections are added together for low word and low image, medium word and medium image and high word and high image, as shown in Table 7.5, it can be seen that low, medium and high words are used most frequently in total to describe correspondingly low, medium and high scale effects.

The data for the number of choices of each word for each image shown in Table 7.2 do not reflect clearly the fact that high effect words are selected in higher numbers than medium effect words and low effect words.  Thus, to represent this better, the numbers for choices of each word for each image were converted into percentages of the total use of the word,

[133] Respondent number 12 for image 5
[134] Respondent number 35, image 4

as shown in Table 7.3. This revealed more clearly how each word was used for the different scale effect images. For example, the selection of ‘fitting’ does not vary greatly between all the images (a difference of 12% between the highest and lowest) and the selection of ‘balanced’ for medium effect is the same for each image (14%). Conversely, the selection of ‘unobtrusive’ for the different images varied greatly (a difference of 31%), with the selection of this word varying as much as 18% for just the low effect images.

The percentage selections of words for each image were combined for the three different scale effects as shown in Table 7.4. This allowed further consideration of which words were used in the most discriminating way for each scale effect. From this analysis, it was found that the words used in the most discriminating way were:

- ‘modest’ for low scale effect (60%);
- ‘balanced’ for medium scale effect (42%); and
- ‘overbearing’ for high scale effect (62.7%).

Comparison between the data in Table 7.3 and those in Tables 7.4 and 7.5 highlight that, even though some words may be used most frequently for a particular scale effect, they may not be used in a discriminating way across the spectrum of scale effects. For example, although ‘dominating’ is used most frequently for images of high effect (*13%, 18% and 19%*), it is also used frequently to describe low and medium scale effects (22.8% and 27.6% respectively) and thus is not used in a very discriminating way.

The combined data for each scale effect word shown in Table 7.4 also reveal that the words for high and low scale effects are used in a much more discriminating way (at percentages of <62.7 and <60.0% respectively) than the words for a medium level of scale effect (<42%). This was not a surprise finding, as it had been difficult during development of the questionnaire to select words to represent medium effects due to their ambiguity and infrequent use, also confirmed during consultation on the pilot studies. Conversely, people seemed to prefer to describe effects in relation to either ends of a spectrum, not the middle.

The findings described above addressed the main aim of the questionnaire to ascertain which words were used most consistently and in the most discriminating way to represent specific scale effects.  This information aids understanding of how scale effects are communicated and also how to describe most clearly scale effects to different people.  A key limitation is that the questionnaire respondents were not representative of the general population of Scotland.  Nonetheless, they included a range of professionals and members of the public interested in the subject of the questionnaire from different locations within three case study areas.  Following these findings, the words ‘overbearing’ and ‘modest’ were identified as the words used in the most discriminating way to represent a high and low level of scale effect respectively and these were thus adopted for the remainder of the research.

## 7.2 Adaptive Choice-Based Conjoint (ACBC) analysis

This section describes the findings of an ACBC study, which formed the final method of this research (illustrated previously in Figure 4.1). For a select number of attributes and types of these (levels), its purpose was to reveal which were most important to people when perceiving scale effect. This was calculated by asking people to make choices for preference based on making trade-offs between the attributes and levels.

Use of ACBC for this research involved a great deal of method exploration and development (as described previously in section 4.3.2 and Appendix D.9). Consequently, the method established and applied represents a new approach to the application of ACBC in landscape architecture.

### *7.2.1 Questionnaire respondents and sampling*

Circulation of the ACBC questionnaire yielded a total of 117 completed questionnaires, with 72 questionnaires abandoned incomplete. It was judged by the researcher that this was a reasonable response based on published literature and given the challenges posed by the questionnaire in terms of the amount of analysis and testing of choices required by participants.

It was not possible to identify in advance a definite sample size required for the ACBC questionnaire as the adaptive process means each participant is given a different number and range of questions based upon their previous responses. Nonetheless, reference was made to guidance provided by Orme (2010, p 57) which describes general factors that should be taken into account when considering the likely sample size required for Conjoint Analysis. These include: what is trying to be measured (such as a subset of respondents or results as a whole); whether differences between features, products or groups are likely to be subtle or strong; and the level of certainty required to address a research question.

After the ACDC data had been collected, in contrast to before, it was possible to measure the sampling adequacy as provided by the reproducibility correlation matrix (with any value larger than 0.5 judged as being sufficient). As shown in Table 7.6 overleaf, the data for this research were analysed and found to meet this threshold required. This meant the sample size for the questionnaire was judged as sufficient.

| Table 7.6: Reproduced correlations for the ACBC attributes | | | | | |
|---|---|---|---|---|---|
| | Context of experience | Landscape type | Size of wind turbine | Proximity of windfarm | Windfarm size |
| Reproduced correlation | .8 | .5 | .9 | .9 | .6 |

The following section of this chapter summarises the demographic characteristics of the questionnaire respondents. As described in chapter 4, it was not expected that these would represent the general population of Scotland given that the sampling was not randomised and, instead, questionnaires were targeted at those interested in and/or with a good knowledge of the research topic.

The respondents (*n=117*) were categorised into five different age ranges: 15 years and under; 16 – 30 years; 31 – 45 years; 46 – 60 years; and over 60 years old. As shown in Figure 7.2 overleaf, the majority of the respondents fell within the 46 – 60 years age group category (*n= 59*), with a fairly even representation of both age groups above and below this level (*n= 26* for age 31-45 and *n=25* for age >60). The smallest category by a notable margin was the youngest age group, 16 – 30 years (*n=7*), and there were no respondents aged 15 years and under (*n=0*). This distribution reflected the fact that the questionnaire was targeted primarily at people interested in the research topic, rather than aiming for an equal distribution of age ranges. It was also targeted at adults as the questions required a relatively high level of understanding of landscape and perception.

The returns revealed almost equal distribution between respondents having visibility (*n=59*) or not (*n=58*) of a wind energy development from their home, but with more living in rural areas (*n=75*) than urban areas (*n=42*), as shown in Figure 7.3 overleaf.

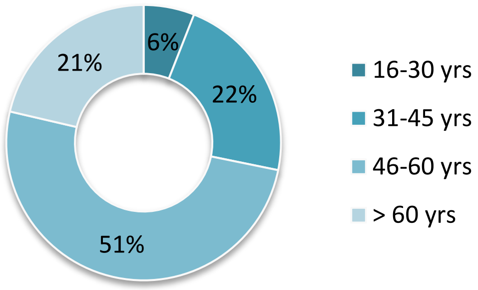



Figure 7.2: ACBC age groups of respondents

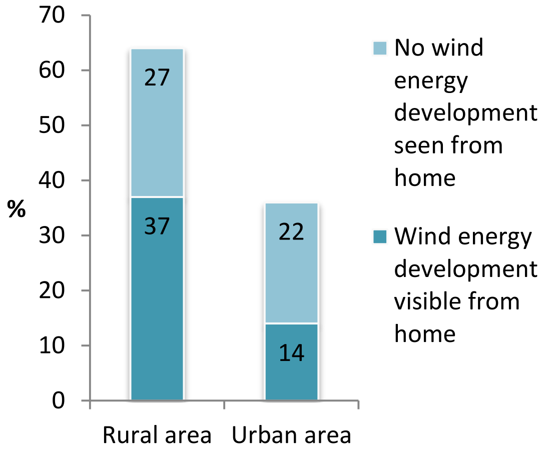



Figure 7.3: ACBC location of residence and visibility of wind energy development

Respondents provided information on their occupation and attitudes to wind energy development. To address the main interests of this research, the responses on occupation were grouped into two categories: likely to be informed about the landscape and the effects of windfarm scale; and not likely to be informed (or unsure how informed) about the landscape and the effects of windfarm scale. The responses on attitudes to wind energy development were also grouped into two categories: positive or likely positive depending on location or proposal; and negative or likely negative irrespective of location or proposal. Following this structure, the occupations and attitudes of the respondents are shown in Figures 7.4 and 7.5 below.

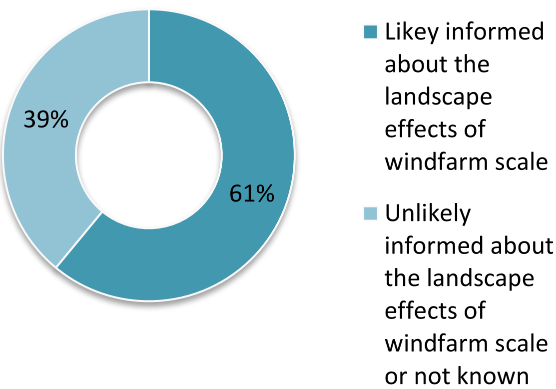



Figure 7.4: Likely knowledge of respondents of the landscape effects of windfarm scale through occupation

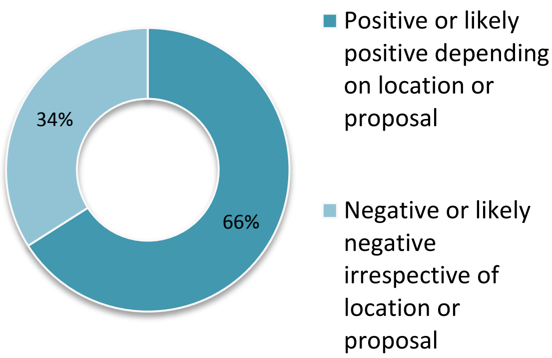



Figure 7.5: Attitude of respondents to wind energy development

Figure 7.4 reveals that the majority of respondents are categorised as being likely (*n=71*) rather than unlikely (*n=46*) to be informed about the landscape effects of windfarm scale through their occupation. This is not unexpected given that the primary recipients of the survey were those interested in wind energy development and/or the landscape.

Figure 7.5 above shows about two-thirds of respondents expressed positive attitudes towards wind energy development (*n=77*) compared with those with negative attitudes (*n=40*). Nonetheless, it must be highlighted that qualifications were attached to some positive attitude choices, such as 'wind turbines are *generally* appropriate within Scottish landscapes' (option 3) or 'wind turbines are suited to some Scottish landscapes, depending on their location and design'. This means that the positive attitudes expressed by respondents were qualified and would not apply to all forms of wind energy development. Although these qualifications are a limitation of the research and mean that the attitude categories are less exclusive, the advantage was that these were more representative of people's attitudes in reality and thus more engaging for participants.

The respondents were asked how many windfarms they had seen within Scotland and outside Scotland over the previous five years. This was because the findings of past research had been variable concerning the link between familiarity, attitudes to windfarms and the perceived landscape effects of windfarms. The responses to these questions are shown in Figure 7.6 below.

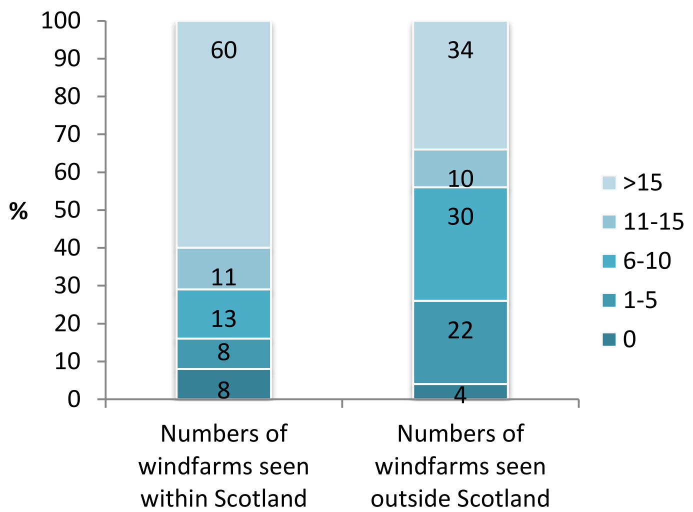



Figure 7.6: Numbers of windfarms seen by respondents during the previous 5 years

Figure 7.6 above reveals that 60% of respondents (*n=70*) had seen over 15 windfarms within Scotland. There were 10 respondents that had not seen a windfarm within Scotland (8%), but nine of these had seen a windfarm outside Scotland; similarly 5 respondents had not seen a windfarm outside Scotland (4%), but 4 of these had seen a windfarm within Scotland. This left only one respondent out of the total number (*n=117*) that had not seen a windfarm within or outside Scotland. Given this very large proportion of all respondents that had seen a high number of windfarms, it was judged that the respondents as a group would have had a sound understanding of the landscape and scale effects of wind energy developments.

### *7.2.2 Research findings of the ACBC analysis questionnaire*

The ACBC questionnaire yielded a very large amount of data. Nonetheless, analysis for this research focused upon that which would best address the specific research questions. The following section sets out the findings and interpretation of the separate data analyses, structured according to the ACBC attributes as follows:

7.2.2.1 Overview of attributes
7.2.2.2 Individual attribute: context of landscape experience
7.2.2.3 Individual attribute: landscape type
7.2.2.4 Individual windfarm attributes: wind turbine proximity, windfarm size and size of wind turbines
7.2.2.5 Comparison of importances across attributes

At the end of this section, there is also a description of the findings of the ACBC Build Your Own (BYO) and screening exercises (section 7.2.3)

#### 7.2.2.1 Overview of attributes

The ACBC questionnaire examined five attributes. Two of these concerned landscape type and how the landscape is experienced, and three concerned windfarm attributes: windfarm proximity, size of wind turbine and windfarm size. The following section provides an overview of the average importances for these five attributes derived from applying Hierarchical Bayes to the raw ACBC data.

Calculation of the average importances for the attributes provided a relative score (by percentage) for each of the attributes that reflects its influence on respondents' perception of a windfarm having an overbearing scale effect, as shown in Figure 7.7 below. The findings show that the three windfarm attributes were judged of greatest importance in creating an overbearing scale effect, with the proximity of a windfarm having the highest importance (26.17%), followed by windfarm size (23.25%) and then size of wind turbine (22.12%). Below these, the context of the experience (17.17%) and landscape type (11.29%) attributes have lower importance scores.

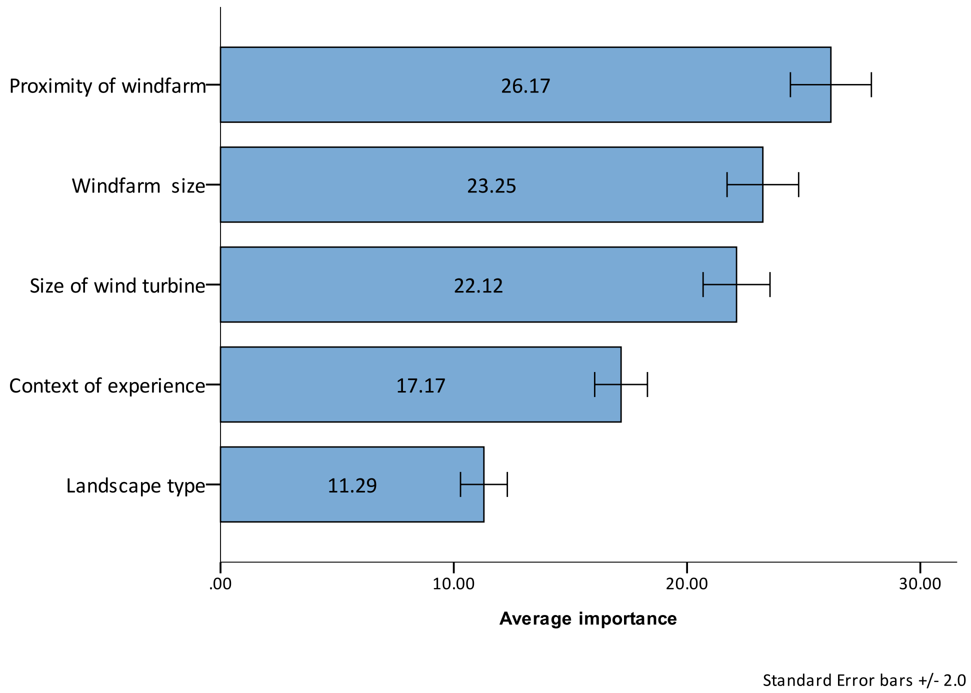



Figure 7.7: Average importances for the attributes

The different scores for the attributes indicate that there is a significant difference between the importance scores for the context of experience and landscape type attributes and between these and the three other attributes. In comparison, there is less difference between the average importances for the proximity, windfarm size and size of wind turbine attributes. To examine the differences between the importance of these windfarm attributes, a non-parametric test was carried out using Friedman (detailed in Appendix G.2.1) that indicated a significant probability of difference between these (*chi square = 8.735, df = 2, P = .013)*. Further application of Wilcoxon revealed that:

- The average importance of the windfarm proximity attribute was significantly different to windfarm size (*z=-2.112, p=.035*);
- The average importance of the windfarm proximity attribute was significantly different to the size of wind turbines (*z=-3.379, p=.001*); but
- The average importance of windfarm size was not different by a significant degree to the size of wind turbines (*z=-8.28, p=.408*).

The ranges between the part-worth utility scores for each of the attributes were also analysed (shown in Appendix G.2.2). This revealed that the differences between these were ranked in the same order as for the average importances, indicating that those attributes with greatest average importances were also those for which importance varies most between the highest and lowest attribute levels.

Taking an overview of the five attributes, it was unexpected that the landscape type and context of experience attributes were ranked so much lower than the three windfarm attributes. This is principally because there is a common belief in landscape architecture practice that the landscape and how it is experienced has most influence on scale effects whatever the characteristics of a development. Nonetheless, it is important to highlight that what these results reveal is not that landscape type and context of experience is less important to people than windfarm attributes in terms of the value or experience of a landscape but, instead, that these attributes are judged as being less influential on people's judgement of an overbearing scale effect. Furthermore, after analysing the data further and discussing this with a range of consultees, a number of additional reasons were identified as possibly influencing this unexpected ranking. One was that this breakdown may reflect the fact that windfarm characteristics can be defined more clearly than landscape characteristics. This may mean that the landscape type and context of experience are not necessarily much less important than the windfarm attributes, but that the wide variety of ways in which they may occur may mean people have a less clear understanding of how they influence the creation of an overbearing scale effect. A second reason may be that, by asking people to make a judgement of an overbearing scale effect, respondents focused more upon the windfarm as the object being introduced to the scenario rather than the context of the experience or landscape type that was the receiving environment (considered as the 'baseline conditions' within EIA).

With regards to the context of experience attribute, there is also a possibility that this was judged less important to scale effect because people feel it is more temporal, their experience not only changing with movement through the landscape, but this also being within their control as they can choose to move. This reasoning is supported by the differences between the part-worth utilities for the different types of context of experience, discussed later, as greater importance was found to be placed on fixed locations. Although this option to alter one's location can also apply to the landscape type attribute, change of type is typically only possible over further distances and thus is not always easy or possible. Conversely, one of the main reasons for the relatively low importance score for landscape type may be that it was just more difficult for people to recognise the relevance of this attribute to their judgement of scale effect in contrast to the other attributes. This may have been influenced by the difficulty of representing the different landscape types within the format of the questionnaire (discussed in Appendix D.9) and is reflected by the small range between the part-worth utilities discussed later in section 7.2.2.3.

It is useful to explore different reasons why the ACBC data were unexpected for the context of experience and landscape type attributes in comparison to the windfarm attributes, based on previous stages of the research. Nonetheless, it is also important to not discount the possibility that the windfarm attributes are more important to people's judgement of an overbearing scale effect than previously understood. The implications of this are discussed further in chapter 8, with particular relevance for strategic plans such as windfarm capacity studies which are conventionally based strongly upon the sensitivity of landscape type, and relatively little attention is given to windfarm categories that tend to be very crude (for example as identified for case study C). In addition, it is also relevant to standard LVIA for windfarms in which great weight is typically placed upon the landscape character type in which a development is located (described in chapter 5), but assessors often consider in little detail the specific scale and proximity of windfarms and the context in which these would be experienced.

With regards to the three windfarm attributes, the ranking of these was unexpected as background research[135] and consultation with both professionals and local people had revealed that wind turbine size was the attribute which most people raised as being most important, followed by windfarm size and then proximity third. There may be a number of reasons for the differences between the apparent importance placed in practice on these attributes compared to those revealed by the ACBC data. One factor may be that, although it is easy to describe the height or number of proposed wind turbines in standard units within a planning response, people actually find it much harder in reality to judge how wind turbine height and extent would affect their perception of an overbearing scale effect. Another factor may be that, for an individual scheme, the number of wind turbines and turbine height has a more constant effect within a study area, but proximity has variable influence that depends on the distance of receptors. This may mean that the importance of proximity alone in influencing scale effect may have been underappreciated in the past, with it typically being raised mainly in relation to specific viewpoints, for example individual houses, visitor attractions, or historic features.

In consultation with landscape architect practitioners, it became apparent that proximity may have also been raised inadequately in the past because people felt there was little scope for this to be changed for a particular scheme. In contrast, people may highlight problems associated with wind turbine numbers and size because they feel there is a greater possibility they can influence the final choices of these. This is an important distinction to highlight: the difference between how people judge the importance of proximity in influencing scale effect and how they actually highlight this during a planning consultation. This is because, whilst it is true that there is usually little scope to adjust the proximity of a scheme to surrounding receptors if it is to be kept within a specific site boundary (often termed the 'developable area'), there are nonetheless other ways in which the importance of proximity can be taken into account. This includes, for example, removal of wind turbines within a particular part of the site, withdrawal of a scheme if its proximity would result in significant adverse scale effects that cannot be mitigated or, alternatively, influencing strategic planning such as sensitivity and capacity studies.

[135] Including the review of responses and representation to planning applications for windfarms described in chapter 1 and Appendix A.6.

In addition to assessing average importances for each attribute across all respondents, comparison was made between the average importances by people with different demographic characteristics. Although demographic differences are not included within the research questions, this analysis helped understand the range and differences between respondents' perceptions and judgements. Through this analysis, it was found that there were no remarkable differences between the average importances according to the age and home location of respondents (rural or urban and from where a windfarm is visible or not), but that there were some differences in relation to the attitudes and occupation of respondents.

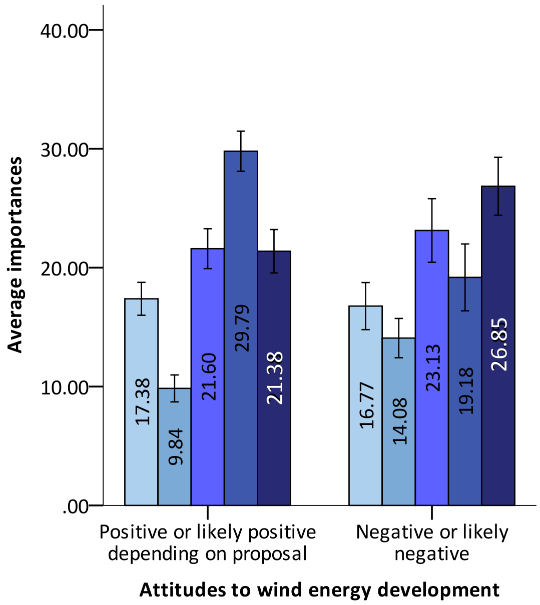



Figure 7.8: Comparison between respondents' attitudes to wind energy development and average importances of attributes

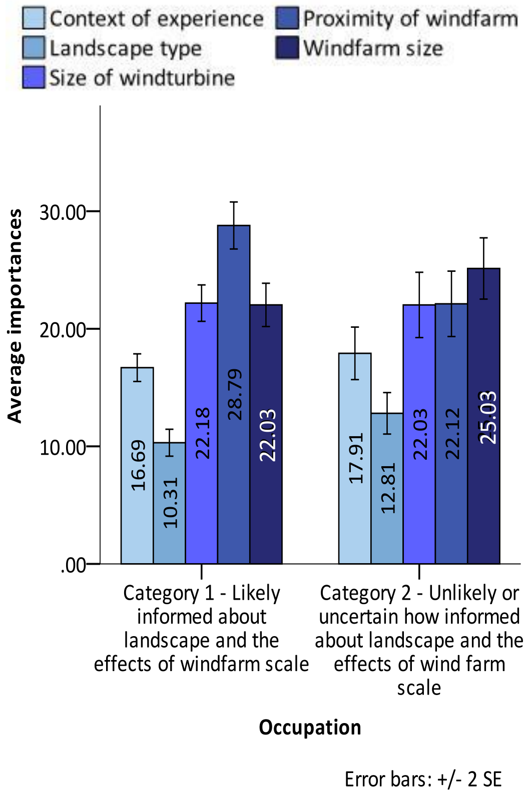



Figure 7.9: Comparison between respondents' occupation and average importances of attributes

It can be seen from Figures 7.8 and 7.9 above that the ranking of the five attributes was similar for all the respondents and the ranking of the landscape type and context of experience attributes were the same for all, revealing a notable amount of consistency. Nonetheless, there were some obvious differences for the three windfarm attributes for those with both a positive attitude and informed occupation or with both a negative attitude and uninformed occupation. These are described further in section 7.2.2.4.

The relationship between respondents' attitudes to wind energy development and knowledge gained through occupation was confirmed by further analysis that revealed that 69.3% of respondents (*n=81*) had a positive attitude combined with an informed occupation or a negative attitude combined with an uninformed occupation. In addition, non-parametric testing using Mann-Whitney confirmed that there is a significant difference in attitude between those with different occupations[136] of $z=-3.684$ *and* $p<0.001$ (further details provided in Appendix G.2.5).

The average importances of the attributes were also compared to the number of windfarms that had been seen by respondents within the previous five years in Scotland, as shown in Figure 7.10 overleaf. This was partly to examine the relationship between people's importances for the attributes and their familiarity of windfarms, as past research findings on this subject had produced variable findings (described previously in 2.7).

The bar graphs show that there is very little difference between the ranking of the average importances of attributes based upon the number of windfarms seen as an indicator of familiarity with windfarms. This was supported further by a non-parametric test using Spearman's rho which revealed no correlation between the average importances of the attributes and the number of windfarms seen (Appendix G.2.6). Nonetheless, it can be seen that there is a slightly smaller range of Standard Error for those that have seen more than 15 windfarms which suggests that there may be less variation in judgements within this group.

[136] in terms of the likelihood of the participant to be informed through their occupation about the landscape and the effects of scale

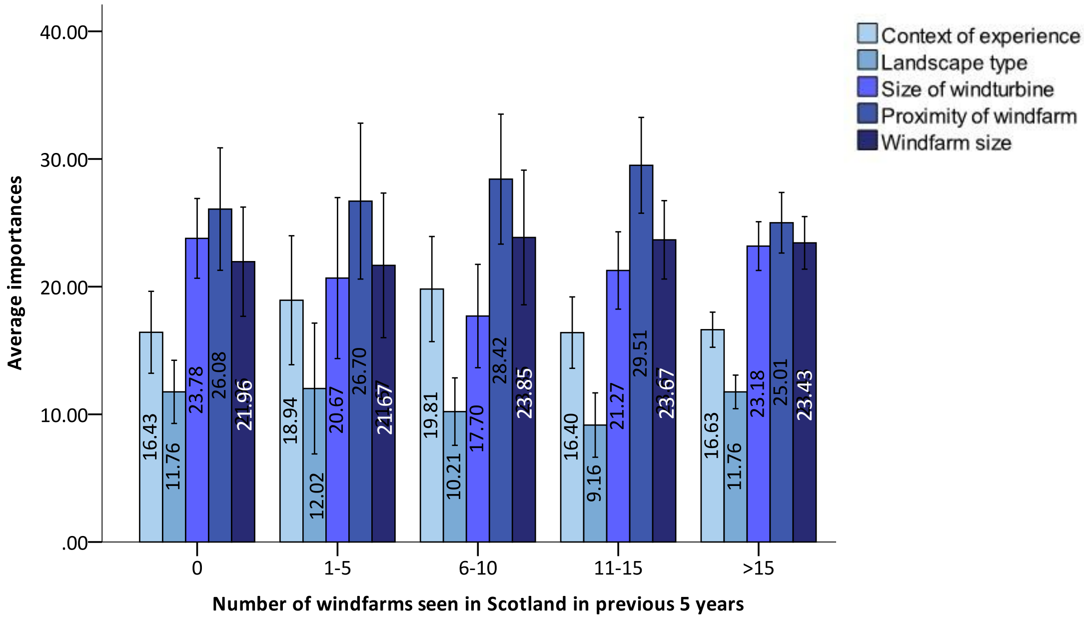



Figure 7.10: Comparison between the number of windfarms seen by respondents and average importances of attributes

### 7.2.2.2 Individual attribute: context of landscape experience

The context of experience attribute levels in combination with the landscape type attribute levels were illustrated within the ACBC questionnaire using simple line drawings, as previously described in the method chapter 4 (and illustrated in full within Table D.9.6 of Appendix D.9). As an example, Figure 7.11 overleaf shows how the different levels of the context of experience attribute were illustrated using conditional graphics[137] for one landscape type.

[137] These are termed 'conditional graphics' by Sawtooth Software SSI Web (version 8.2.4) for ACBC analysis. This is because images for every scenario of attributes are uploaded to the questionnaire file and then the questionnaire software 'selects' which image to show conditional on the specific attributes being presented by the conjoint question.

Figure 7.11: How context of experience was illustrated within the ACBC questionnaire for one landscape type (seen in an agricultural and settled landscape). From top to bottom, left to right: seen from the window of a sitting room within a house; seen from a garden; seen while on a local, lowland walk; seen from a local hill top; and seen while driving a car

The part-worth utility scores for the separate levels of the context of experience attribute are shown in Figure 7.12 below. These reveal that the context of experience level judged as being of greatest importance was where a windfarm would be seen from the window of a sitting room within a house, followed in order by: seen from a garden; seen while on a local lowland walk; seen from a local hill-top; and seen while driving a car.

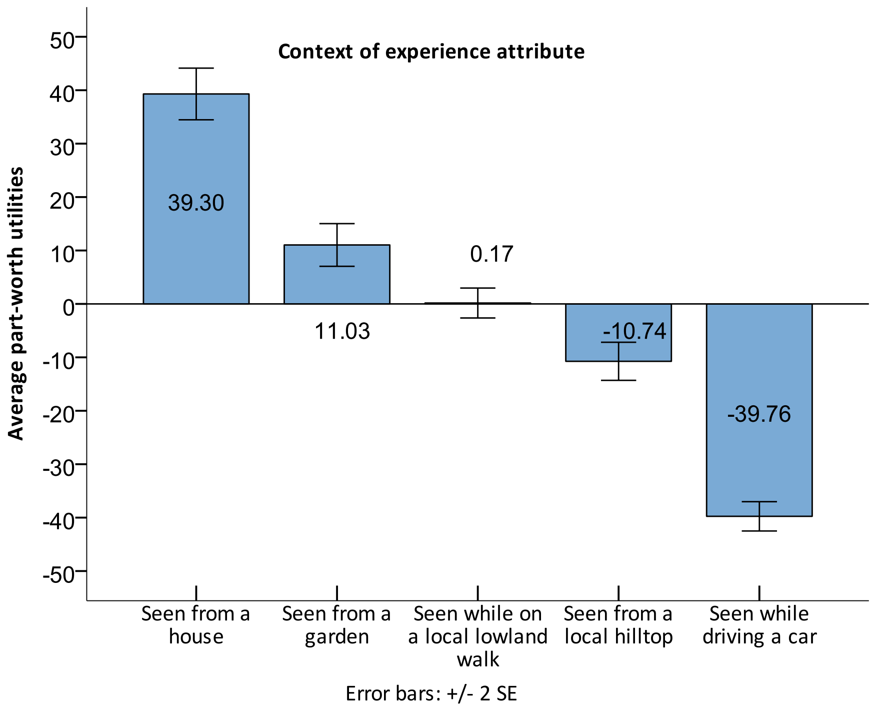


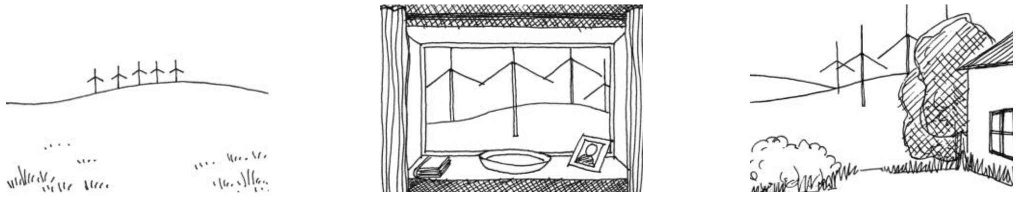

Figure 7.12: Part-worth utility scores indicating relative importance of the different context of experience levels

It can be seen in Figure 7.12 that the ranges of Standard Error for the part-worth utility scores for the three middle levels (seen from a garden, seen while on a local lowland walk, and seen from a local hill-top) were relatively close. Nonetheless, non-parametric tests carried out using Friedman and Wilcoxon (reported in Appendix G.2.7) confirmed that the average part-worth utility scores between all three were significantly different.

The ranking of the part-worth utility scores for the different levels of the context of experience attribute support earlier stages of the research by indicating that a windfarm will typically be judged as most overbearing upon the experience of a private/ personal space, such as a house or garden, rather than a publicly accessible location, such as a hill-top or road. This is likely to be influenced also by the sense of refuge that may be valued within an enclosed and/or private space, as identified during the experiential landscape assessment.

The difference between the importance scores for perceiving an overbearing scale effect from a house or from a garden (28.27) may reflect the perceived scope to move away from exposure to this effect. An important consideration here is that the house attribute level was described as 'seen from the window of a sitting room within a house' which would provide a fixed view that would be unlikely to be avoided easily, and in a room in which you would expect most people to spend a considerable amount of time.

The downward ranking of importance scores from a view from a house to a garden, and then to a local lowland walk and hill top is likely to also relate to the increasing field of view visible or extent of open space. In this respect, it was important to consider the nature of the illustrations provided for the levels within the questionnaire. For example, the image of the view from the house showed the view framed by the window surround, which would mean the view would be focused upon a windfarm if present, and this may appear to 'fill' the view available if the development was sufficiently large and/or close, with no surrounding open space visible. This sensitivity was raised during consultation for the experiential landscape assessment, with one resident highlighting she was particularly worried about proposed wind turbines being so high, extensive and close that the tops of the wind turbines and the edge of the development would not be visible through her windows, so she would not be able to see any limits to the development or its surrounding context[138].



Open Framed Partially framed

Figure 7.13: Framing of view influencing perception of an overbearing scale effect

Another factor raised during earlier stages of the research that may have affected the differences in the part-worth utilities was the likely duration of an overbearing scale effect. This would be permanent (for the duration that the windfarm existed) when experienced from a house or garden, but likely to be temporary whilst on a local walk or when visiting a local hill top and, finally, briefest when driving through a landscape.

The relatively high importance scores for a windfarm being seen from houses or gardens is an important finding with regards to how a development may affect a community. This is because the focus of LVIA and EIA (including analysis from representative viewpoints) is typically on public and more open and extensive areas because it is judged that the effects on local people are likely to be more personal and variable. Conversely, the findings of this ACBC questionnaire support the findings of the experiential landscape assessment which identified that there is a collective importance of scale effects within a landscape experienced by local residents, workers and visitors. The typical under-recognition of these effects was highlighted by one respondent to the ACBC questionnaire that stated within the comments box at the end of the questionnaire: '*Excellent questions, made me think about my own perceptions and was surprised by what I found; thought I would see protection of the public landscape as the most important aspect, but turns out I felt the private garden would be most affected – ie views by those who don't have a choice, that have to live with and look at the wind farm every day*'.

[138] Experiential landscape assessment for case study B

One of the most notable findings with respect to the relative importances of the context of experience attribute was the consistency of responses. This was contrary to frequent suggestions made in the past that the importance of how a landscape is experienced is a very personal or individual judgement. Conversely, very little difference was found between the part-worth utility scores for this attribute and the different demographic characteristics of respondents, including for occupation, location, age or number of windfarms seen in the previous five years. The only slight difference between the context of experience part-worth utilities and respondent characteristics was identified for people's attitudes to windfarms (as shown in Appendix G.2.8). In this respect, it was revealed that there was no significant difference between the three middle ranked part-worth utility scores (seen from a local hilltop, on a lowland walk or from a garden) for those with a negative attitude to windfarms. It seemed, conversely, that those with negative attitudes to windfarms judged importance most strongly related to the extremes of the attribute levels, but the reasons for this is unclear and thus this would benefit from additional research in the future.

There were some attributes that could not be included within the ACBC part of the questionnaire (as described within the method chapter 4), but could nonetheless be considered using 'select' questions that required respondents to choose between a number of options. One of these questions regarding the context of landscape experience asked respondents to select which position and relative elevation of a windfarm to a viewer would appear most overbearing, as illustrated below in Figure 7.14.

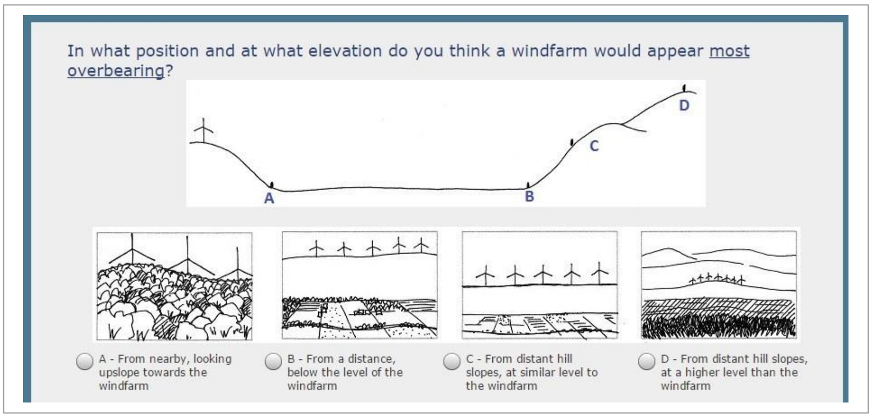



Figure 7.14: Selective question about the relative elevation and position of a windfarm

The responses to this question are shown in Figure 7.15 opposite. This reveals that a large majority (*n=91*) of total respondents (*n=117*) judged that a windfarm would appear most overbearing when nearby and looking upslope towards it, followed by it being most overbearing from a distance, when looking from below the level of the windfarm (*n=16*) and then from distant hill slopes, at a similar level to the windfarm (*n=10*).

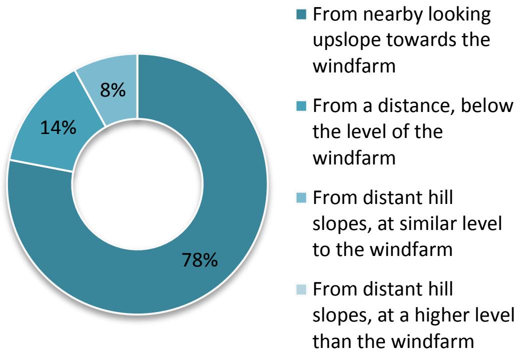



Figure 7.15: Perception of the most overbearing scale effect in relation to differences of elevation and distance

None of the respondents (*n=0*) selected the forth option: that the windfarm would appear most overbearing from distant hill slopes, at a higher level than the windfarm. These findings were consistent across all respondents in relation to the demographic characteristics.

These data were not unexpected, but are nonetheless useful in supporting previous findings from the LVIA and experiential landscape assessment research stages with regards to perceived scale effect of a windfarm being greater where located at a higher elevation than a viewer. They also support the finding of the ACBC described previously regarding the high level of importance of the proximity of a windfarm influencing a judgement of an overbearing scale effect. Furthermore, the lack of selection of option 4 by any respondents (that a windfarm would appear most overbearing from distant hill slopes at a higher elevation than the windfarm) in contrast to option 3 (*n=16*) (from distant hill slopes at similar level to the windfarm) highlights that a windfarm was judged by respondents to appear less overbearing when viewed from above.

Although the LVIA and experiential landscape assessment research stages also identified that a windfarm had a more overbearing scale effect when seen from close proximity and lower elevation, the illustration of the scale effect for this scenario within the ACBC questionnaire was particularly important. This is because it showed the wind turbines being only partially visible above the intervening sloped landform and woodland canopy. The reason for showing this was an apparent contradiction during earlier stages of the research when local people often highlighted the overbearing scale effect of seeing wind turbines ‘popping up’ above the skyline, even if their entire size could not be seen, whilst consultants often described within LVIA reports that scale effects were mitigated to a significant degree by the partial screening in these circumstances. What the findings of the ACBC questionnaire confirm is that, even if the visible height or extent of wind turbines may be reduced at close proximity due to fore and mid-ground screening, the overall scale effect judged by most people is influenced more strongly by perceived proximity, object recognition and relative elevation, irrespective of the proportion of wind turbines visible. This supports the findings of the experiential landscape assessment and suggests that LVIA practitioners need to reconsider their assessment of scale effects in these situations.

The responses to this question concerning elevation also supported previous findings of the LVIA and experiential landscape assessment research in terms of how higher elevation of a viewer influenced perceived scale with greater visibility of distance cues. Furthermore, this was supported by consultation on the interim findings of the ACBC questionnaire, as consultees highlighted that, from below, a windfarm often seemed overbearing not just because of its elevation above a viewer, but because you couldn’t be sure how far away it was due to intervening screening. Conversely, when looking from above, you were not only looking down on the development (so it seemed less overbearing in terms of relative elevation), but it was easier to see distance cues and thus be able to reassure yourself that it was distant.

The ACBC questionnaire also considered the relationship between the context of experience attribute levels and cumulative effects via a number of select questions. This followed responses during the earlier stages of the research which raised issues with regards to the distribution of effects, such as the influence of clustering or dispersal of windfarms on perception of an overbearing scale effect. To address this issue, the questionnaire asked participants whether they thought seeing more than one development in one direction or seeing more than one development in different directions would have most overbearing scale effect. The contexts of the experience for these scenarios were from a house, a garden, whilst on a local walk or whilst driving. An example of one question is shown in Figure 7.16 overleaf.


Figure 7.16: Example from ACBC questionnaire of selective question regarding the cumulative effects of windfarms

The responses to the questionnaire revealed a clear majority of 63.5% of respondents (averaged over all the levels) who judged that seeing more than one windfarm in two different directions would appear most overbearing. The data show a high level of consistency across all participants, with no significant differences in relation to respondents' demographic characteristics.

#### 7.2.2.3 Individual attribute: landscape type

For the landscape type attribute of the ACBC questionnaire, four levels were provided: an agricultural and settled landscape; a moorland landscape; backcloth hills above a mixed landscape pattern; and a wooded landscape. These levels are on a nominal scale, representing different characteristics or elements such as landscape pattern, the scale of spaces, vegetation, access and landform. They are influenced by how they are experienced and thus were illustrated within the ACBC questionnaire in combination with the context of experience attribute.

As an example, Figure 7.17 below shows how the landscape type attribute levels were illustrated for one context of experience level within the ACBC questionnaire.

Figure 7.17: How landscape type was illustrated within the ACBC questionnaire for one context of experience (seen while on a local, lowland walk). From left to right: Seen in an agricultural and settled landscape; seen in a moorland landscape; seen upon backcloth hills above a mixed landscape pattern; and seen in a wooded landscape.

With regards to the wooded landscape type, it is highlighted that a continuous canopy was illustrated, apart from a small open area in the foreground to allow a view into the woodland. This is relevant to discussion later about perception of scale and distance and the scale of spaces which would be different in a landscape with separate woodland blocks.

Figure 7.18 below indicates the part-worth utility scores for the different landscape type attribute levels.

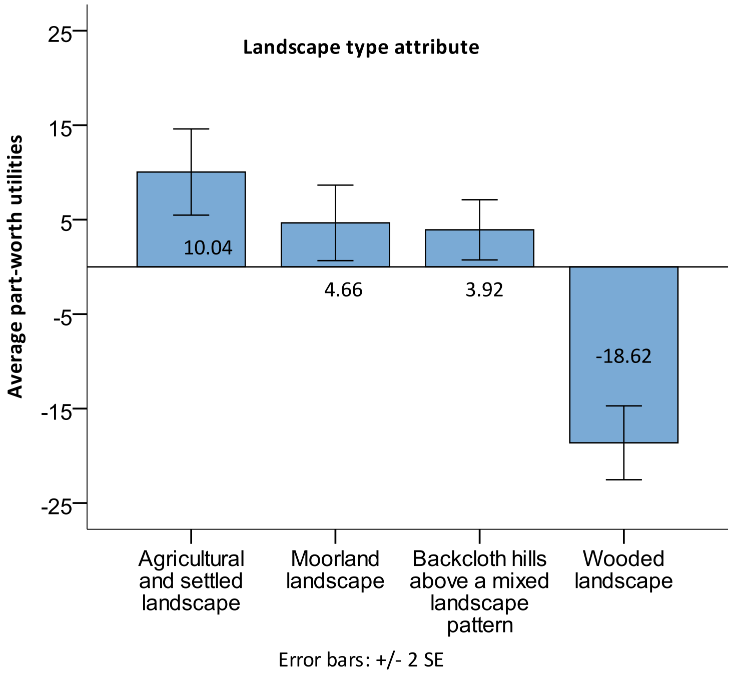


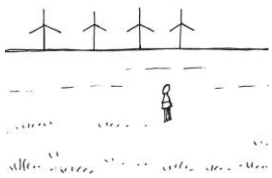

Figure 7.18: Part-worth utility scores for the levels of landscape type attribute

There is a total range of 28.66 between the highest and lowest part-worth utility scores for landscape type which is much less than the other attributes within the ACBC questionnaire (shown in Appendix G.2.2). Nonetheless this smaller range was expected, because the landscape type attribute levels are nominal and combine a number of different landscape characteristics and elements which may have varying and sometimes opposing influence on the perception of scale effect. For example, a structure may seem overbearing in scale in relation to residential buildings within a settled landscape, but also less incongruous in scale because the landscape includes other vertical built elements. This is also a key reason for the relatively high Standard Errors for the part-worth utility scores.

Figure 7.18 shows that the respondents to the ACBC questionnaire judged that an agricultural and settled landscape would be the landscape type in which a windfarm would be most likely to have an overbearing scale effect, and a wooded landscape would be least likely. Nonetheless, there is not a great difference between the part-worth utility scores for the three highest scores for agricultural and settled landscape, moorland landscape, and backcloth hills above a mixed landscape pattern (a range of 6.12). Non-parametric tests using Friedman and Wilcoxon confirmed that the differences between the first and second of these scores and the second and third of these scores are not significant (Appendix G.2.9), but that they are significant between the agricultural and settled landscape and the backcloth hills above a mixed landscape pattern attribute levels (*Z=-2.090, Asymp Sig (2-tailed) p=.037*).

It had been expected that the part-worth utilities would be similar for the agricultural and settled landscape attribute level and the backcloth hills attribute level. This was because previous methods of the research and published literature had identified that the elements of landscape pattern that were present in both these levels strongly influenced perception of scale effect by providing scale and distance cues. Nonetheless, for the same reason, it had not been predicted that the part-worth utility score for the moorland landscape type would be relatively high and similar to both the settled landscape types. In addition, it was a surprise that the difference between the part-worth utility scores for moorland and wooded landscape types (22.54) was so high given that both types are simple in landscape pattern and lack scale references.

Further analysis and consultation suggested that the apparent anomaly for the part-worth utility score for moorland compared to woodland may be due to contrasting influences also identified during the LVIA and experiential landscape assessment research. Following these, although moorland, like woodland, lacks human elements which may be perceived as sensitive to the overbearing scale effect of a windfarm, it may nonetheless be judged as sensitive to scale because its openness means there is no obvious spatial separation between a viewer and a windfarm, nor any way to be able to be sure that a windfarm is far away. Given the relatively high part-worth utility scores for moorland compared to woodland, it seems that, despite competing factors affecting perception of scale effects within these landscapes, lack of spatial separation is the stronger influence.



No scale cues within moorland, but openness means windfarm has overbearing scale effects directly upon viewer

No scale cues within woodland, but perceived separation of windfarm by trees means scale effects upon viewer are perceived to be less overbearing

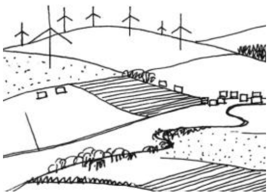
Figure7.19: Difference of perceived separation between a windfarm and a viewer within woodland and moorland landscapes

Another reason for the relatively low part-worth utility score for the wooded landscape type may be respondents' high expectations for trees to diminish the vertical scale effects of windfarms. These expectations contrast to the findings of the other methods of this research which found that woodland does not typically reduce scale effects significantly, for example due to object recognition and the disparity of scale between wind turbines and trees. Nonetheless, it would not be surprising if many participants of the questionnaire had higher expectations than reality, as these are expressed frequently[139], usually on the basis of the screening ability of trees for much smaller elements within our landscape, such as houses. In addition, these expectations may have been influenced by the relatively small number of windfarms currently operational within woodland in Scotland from which people could draw experience.

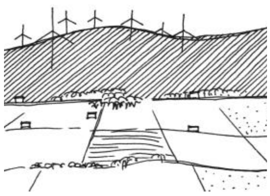
It is shown in Figure 7.18 that the part-worth utility score for the backcloth hills above a mixed landscape pattern attribute level is ranked third lowest, below an agricultural and settled landscape and a moorland landscape. This finding was surprising because it had been expected that the part-worth utility score for the backcloth hills would have been higher than that of an agricultural and settled landscape. This was because the backcloth hills type not only contains similar intricacies of landscape pattern and receptors as the agricultural and settled landscape, but also a clearly distinguishable hill backcloth with which direct scale reference would be made and upon which a windfarm would be higher in

[139] For example as described within the LVIA for the case study B windfarm

elevation (identified previously as resulting in a more overbearing scale effect). It was suspected initially that this unexpected scoring may have resulted from misunderstanding of the character of the different landscapes as portrayed through the diagrams and titles (as it had been difficult to convey the differences through these formats). In contrast, though, in reference to the demographic data, it became apparent that it was the respondents that were more informed (through occupation) and more familiar with windfarms (through the number of windfarms they had seen) that had judged that an overbearing scale effect would be less likely to occur in the backcloth hills landscape type. Although the small differences between the part-worth utilities for these two attribute levels means conclusions should be drawn with caution, this finding seems to point once again to perceived spatial separation of a development from receptors being more influential on judgement of scale effects than scale references and elevation, as illustrated in Figure 7.20 below.



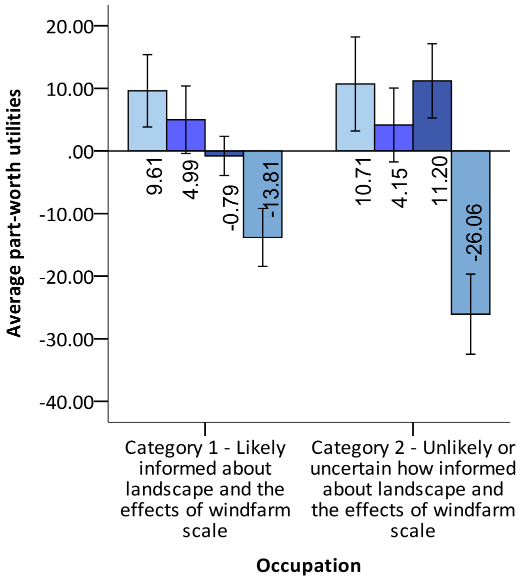
Scale effects continue 'uninterrupted' between the windfarm and receptors within an agricultural and settled landscape



Same windfarm with greater perceived separation of effects upon distinct backcloth hills above a mixed landscape pattern

Figure 7.20: Different scale effects influenced by spatial separation within the agricultural and settled landscape type and the backcloth hills above mixed settlement pattern landscape type

Alike the analysis described previously for the context of experience attribute, comparison was made between the part-worth utility scores for the landscape type attribute and the different demographic characteristics of respondents. Similarly, this found that there was generally a high level of consistency across all respondents, including of different age, in different locations or having seen a different number of windfarms. Nonetheless, there was a notable difference in the part-worth utility scores for the backcloth hills landscape type based upon respondents' occupation and attitudes as shown in Figures 7.21 and 7.22 overleaf.



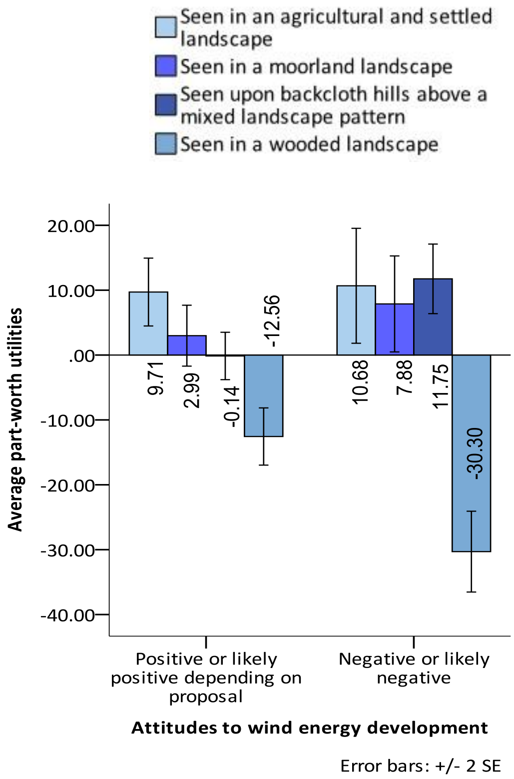




Figure 7.21: Comparison between respondents' occupation and landscape type part-worth utilities

Figure 7.22: Comparison between respondents' attitude to wind energy development and landscape type part-worth utilities

It is not clear why the relative importance of the backcloth hills landscape type is greater for those uniformed by their occupation and possessing a negative attitude to wind energy development, although this could relate to an increased importance for these respondents of the presence of residences within these landscapes similar to the agricultural and settled landscape type. This would benefit from further research in the future.

#### 7.2.2.4 Individual windfarm attributes: windfarm proximity, windfarm size and size of wind turbines

The following section describes the findings of the ACBC questionnaire with regards to the three windfarm attributes: windfarm proximity; windfarm size; and size of wind turbines.

The rankings of the part-worth utilities for the three windfarm attributes were all predictable: that is a windfarm is judged as being more overbearing in scale effect with larger wind turbines, a higher number of wind turbines and located at closer proximity.

Thus it was not the ranking of the part-worth utility scores for each windfarm attribute that was of particular interest to this research but, instead, the relationships and differences between the windfarm attributes and their levels and with the context of experience and landscape type attributes.

Of the three windfarm attributes considered by the ACBC questionnaire, the proximity of windfarm attribute was highest in relative importance (26.17), followed by windfarm size (23.25) and size of wind turbine (22.12), as shown previously in Figure 7.7.

The highest ranking of average importances for the proximity attribute is an important finding, as there has often been an assumption in practice (not within published literature on visual perception) that the influence of the proximity of wind turbines is directly inverse to the size of wind turbines, ie: large wind turbines located far away are predicted to have the same effect as small wind turbines nearby. Conversely, the findings of this research, which identifies that the judged importance of proximity is significantly different to that for the size of wind turbines, highlights the greater complexity of influences on perception of scale effect.

Although the relationship between wind turbine size and proximity is not constant, non-parametric tests using Spearman's rho (Appendix G.2.10) identified a positive correlation between how respondents judged the importance of these two attributes (*correlation coefficient = .258, significance (2-tailed) p=.005, n=117*). Conversely, data analysis revealed there was no correlation between the average importances for wind turbine size and windfarm size (*correlation coefficient = -.103, significance (2-tailed) p=.268, n=117*), nor any correlation (Appendix G.2.10) between wind turbine size and the extent of windfarms judged as creating an overbearing cumulative scale effect *(Correlation coefficient = -.121, significance (2-tailed) p=.192, n=117)*. This suggests that respondents' judgements of an overbearing scale effect are quite different when considering vertical scale and proximity in comparison to when considering horizontal scale and extent. This is an important finding, as it is sometimes suggested by practitioners that the vertical scale effects of wind turbine height are equivalent to the horizontal scale effects of wind turbine numbers or extent, ie a similar scale effect results from fewer large wind turbines or a greater number or small wind turbines.

The average importances for the three windfarm attributes were compared to the demographic characteristics of respondents. This revealed a consistency of responses, alike those for the landscape and experiential attributes, across age, location and number of windfarms seen. Similarly, there was also a slight difference in the rankings of the relative importances for the three windfarm attributes in relation to the attitudes and occupations of respondents, as shown in Figures 7.23 and 7.24 overleaf. These reveal that the proximity of a windfarm is the most important attribute influencing a judgement of an overbearing scale effect for those with a positive attitude and informed occupation, but there is little difference for these same respondents between the importances of windfarm size and wind turbine size. Conversely, for those with a negative attitude and uninformed occupation, windfarm size ranks highest in importance, but the scores for all three windfarm attributes are similar (only windfarm size being significantly different).

Although research in the past has indicated a relationship between attitudes to windfarms and knowledge of them with perceived landscape and visual effects of a windfarm, this doesn't explain why those with a negative attitude and/or uninformed by their occupation might rate differently the importance of separate windfarm attributes with regards to scale effect. One factor could be different people's understanding of the influence of the different attributes, but this does not fit with the consistent responses received in relation to numbers of wind turbines seen. For these reasons, it would be useful to consider further these relationships through additional research in the future.

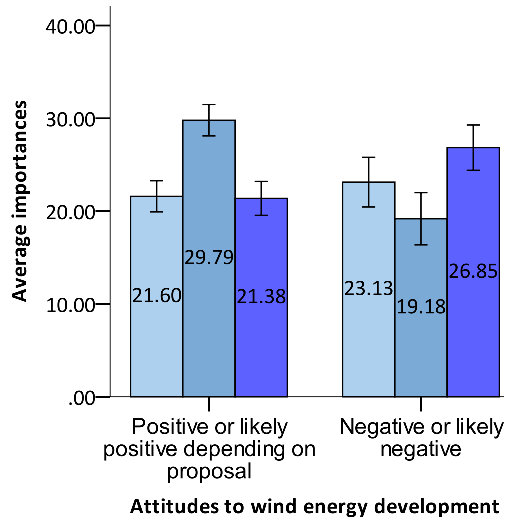



Figure 7.23: Comparison between respondents' attitude to wind energy development and average importances for the windfarm attributes

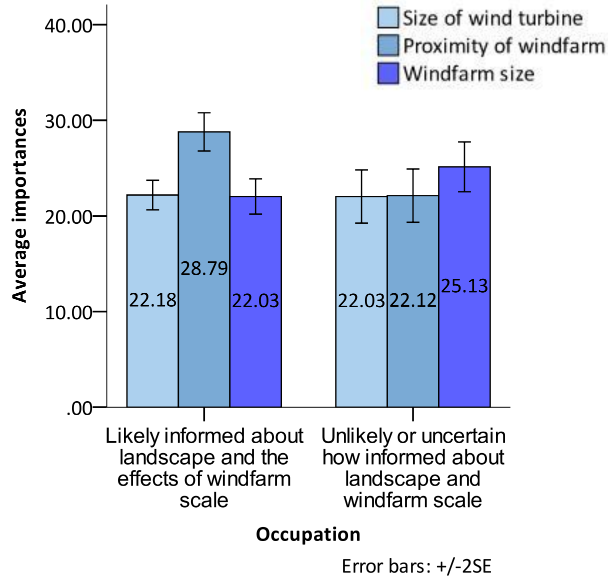



Figure 7.24: Comparison between respondents' occupation and average importances for the windfarm attributes

Figures 7.25, 7.26 (below) and 7.27 (overleaf) show the part-worth utility scores for the wind turbine size, windfarm proximity and windfarm size attributes.

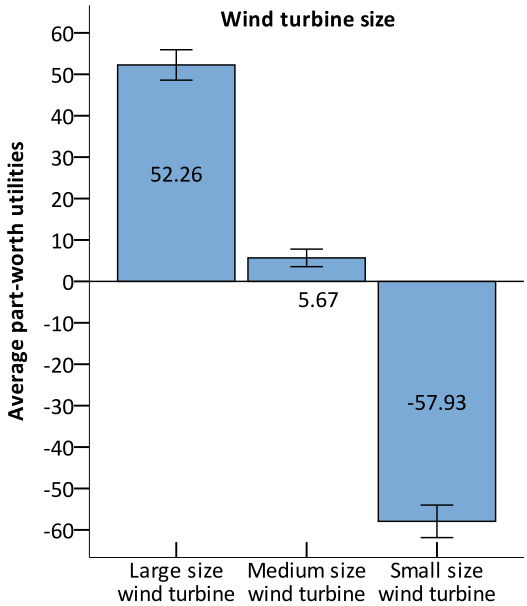



Figure 7.25: Part-worth utility scores for wind turbine size

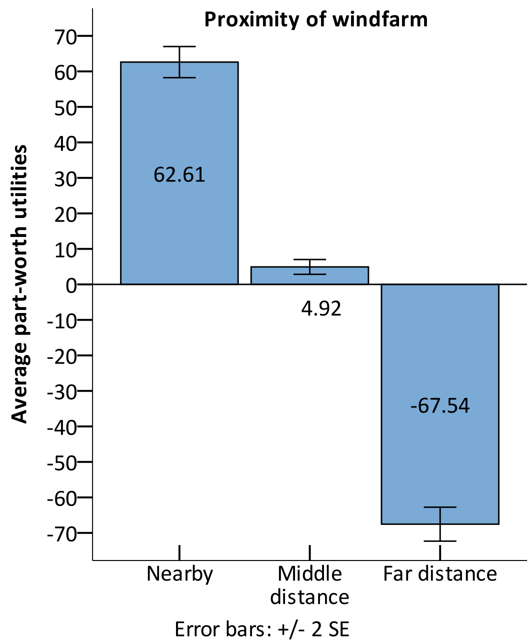



Figure 7.26: Part-worth utility scores for windfarm proximity

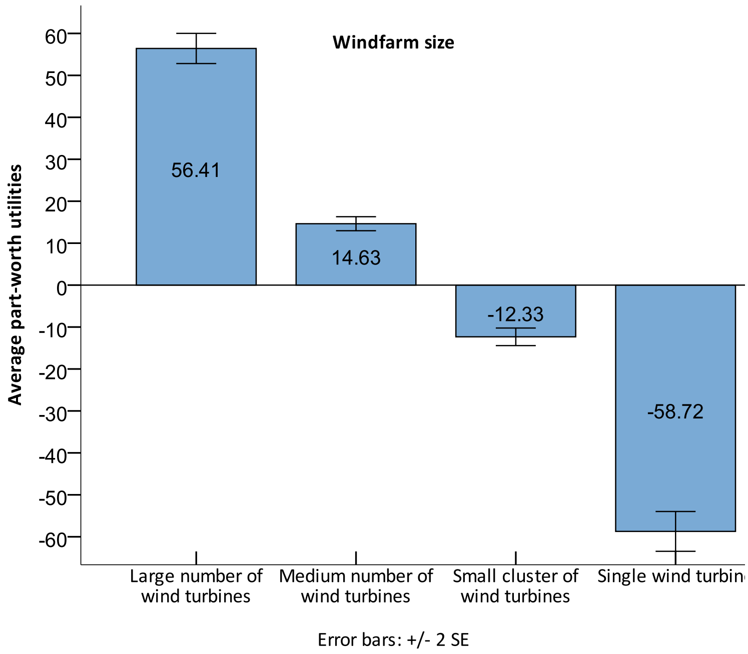
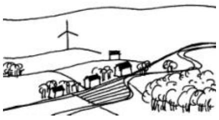
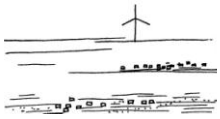
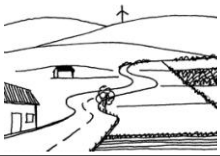
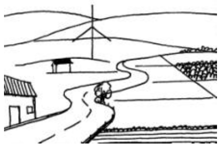
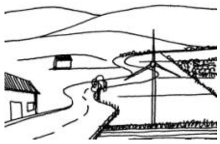
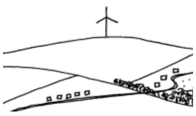
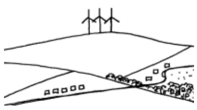
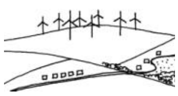
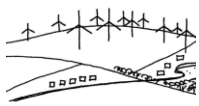



Figure 7.27: Part-worth utility scores for windfarm size

The large range between the highest and lowest part-worth utility scores for the windfarm attributes had been expected because the levels represent ordinal and ratio data across the spectrum of scale and are zero centred. Nonetheless, there are some differences between the part-worth utilities for the different attribute levels that are useful to consider further, as described within the following section. Table 7.7 overleaf shows these differences (numbers in red) in relation to the descriptions of the attribute levels provided within the guidance for participants that accompanied the ACBC questionnaire (reproduced in Appendix D.11).

<table>
<tr><td colspan="5">Table 7.7: Differences in the part-worth utility scores for the windfarm attribute levels</td></tr>
<tr><td colspan="5">Wind turbine size</td></tr>
<tr><td>Small</td><td></td><td>Medium</td><td></td><td>Large</td></tr>
<tr><td></td><td>Difference of importance<br>63.60</td><td></td><td>Difference of importance<br>46.59</td><td></td></tr>
<tr><td colspan="2">Scale references tend to be domestic, for example houses or woodland blocks. Within a broader landscape setting, the turbines appear as minor elements.</td><td>Scale references tend to occur at a local level, but typically for collective characteristics such as a settlement, local hills or forest plantations, rather than individual or domestic elements.</td><td colspan="2">Scale references tend to occur at the broad level, for example a range of hills or mountains, a loch or the sea. These wind turbines seems disparate in scale to domestic landscape features.</td></tr>
</table>

<table>
<tr><td colspan="5">Windfarm proximity</td></tr>
<tr><td>Far distance</td><td></td><td>Middle distance</td><td></td><td>Nearby</td></tr>
<tr><td></td><td>Difference of importance<br>72.46</td><td></td><td>Difference of importance<br>57.69</td><td></td></tr>
<tr><td colspan="2">The windfarm appears far away, although its actual distance tends to be unclear with no direct link to the viewer. References are typically made with the landform skyline.</td><td>The windfarm appears neither close by, nor in the far distance – appearing located within the mid-ground. References for distance are typically made with elements of the landscape pattern and landform horizons.</td><td colspan="2">References for distance are made directly with the viewer themselves, the foreground of their view and the wind turbine appears within the immediate surroundings.</td></tr>
</table>

<table>
<tr><td colspan="7">Windfarm size</td></tr>
<tr><td>Single wind turbine</td><td></td><td>Small cluster</td><td></td><td>Medium size</td><td></td><td>Large size</td></tr>
<tr><td></td><td>Difference of importance<br>46.39</td><td></td><td>Difference of importance<br>26.96</td><td></td><td>Difference of importance<br>41.7</td><td></td></tr>
<tr><td colspan="2">A single wind turbine creates a single point feature within the landscape.</td><td colspan="2">This exists where the number of wind turbines is large enough to create a collective group, but few enough to avoid appearing complex or extensive and still appearing as an isolated point feature.</td><td colspan="2">The wind turbines are numerous enough to appear complex in their collective form and to cover a fairly large area and be seen to have a different image from different locations within the area. However, they are not so great in numbers that they seem collectively extensive and to cover different landscape areas.</td><td>This exists where there are many wind turbines that do not appear individually distinctive but, alternatively, seem like a large collective mass (comparable to a ‘forest’ of turbines) that appears extensive and to cover different landscape areas.</td></tr>
</table>

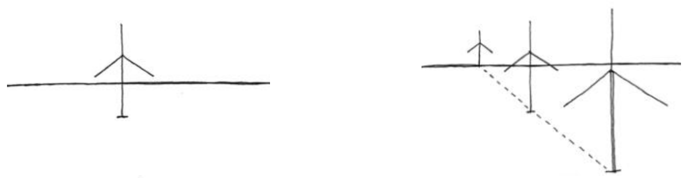
For both wind turbine size and windfarm proximity, shown in Figures 7.25 and 7.26, it can be seen that the medium level part-worth utility score is not located half-way in-between the highest and lowest levels[140]. This means there is a greater gain in importance by changing a scheme from medium-sized wind turbines to small-sized (63.6) than for changing a scheme from having large-sized to medium-sized wind turbines (46.59). In addition, there is also a greater gain in importance by changing a scheme from being in the middle-distance to the far distance (72.46), than from the nearby to the middle distance (57.69).

These findings are very interesting, as they indicate that a key threshold of effect occurs between the low and medium levels for both the wind turbine size and windfarm proximity attributes, meaning that further change between the medium to high levels has less magnitude of effect. In reference to Table 7.7, this indicates that the greatest change in judgement of an overbearing scale effect for wind turbine size occurs when the wind turbine scale references go from being at a domestic level, to when the scale references occur at the level of a local community, hills or forest. For the proximity of a windfarm, in reference to Table 7.7, it can be seen that there is also a greater difference when changing from a windfarm being seen in relation to elements of the mid-ground landscape pattern and landform horizons (with which the viewer can make direct scale reference) to where it is seen in relation to the distant landform skyline and there is no direct scale reference with the viewer. These differences between the levels were slightly surprising because, although there is a clear rationale in relation to different scale references, consultation and review of responses and representations to planning applications during earlier stages of the research found people tended to focus their concerns on wind turbines that were very close to viewpoints or residences. In contrast, little attention was typically paid to the importance of siting a windfarm so that it was mainly seen in the far distance rather than within the mid-ground of views.

With regards to the windfarm size attribute, as shown in Figure 7.27 and Table 7.7, it is important to highlight that this is different to the other windfarm attributes in that there

[140] Note: For proximity, far distance is the lowest level, although this reflects the largest dimension, and nearby is the highest level.

are four levels: large; medium; small cluster; and single wind turbine. The guidance accompanying the questionnaire (shown in Appendix D.11) explained the distinction between these different levels (also summarised above in Table 7.7). It can be seen from the bar graph in Figure 7.27 that the relationship between the part-worth utilities and the different levels of the attributes is not constant, with a difference of 46.39 between the single wind turbine and small cluster of wind turbines, but only 26.96 between the small cluster and medium number of wind turbines, and 41.78 between this and a large number of wind turbines. This larger difference between a small cluster of wind turbines and a single wind turbine is not surprising, as it supports existing guidance (SNH, 2014a) and findings from the LVIA research that highlights that, although small clusters of wind turbines and single wind turbines both form a single concentrated focal feature, the more complex collective form (including movement) of a cluster is more likely to create an overbearing scale effect. In addition, the siting of more than one wind turbine can aid perception of distance, as shown in Figure 7.28 below, and thus influence the perception of a windfarm appearing overbearing.



Single wind turbine marks a point in space, but cannot alone indicate distance

Numerous wind turbines mark spaces that can aid perception of distance

Figure 7.28: Diagram showing difference between one and three wind turbines for providing a distance cue

Less expected than the difference between the part-worth utility scores for a single wind turbine and a small cluster, was the large difference in scores of 41.78 between a medium-sized and large-sized windfarm, compared to the difference of 26.96 between a small cluster and medium-sized windfarm. This is because participants of earlier stages of the research had often suggested that the overbearing scale effect of a large-sized windfarm would not be significantly greater than that for a medium-sized windfarm (ie because the threshold for an overbearing scale effect had already been crossed at the medium size). Indeed, for the same reason, developers often propose extensions to windfarms that take these from the medium to the large size and LVIAs identify the additional effects of these to be not significant in relation to the baseline. In contrast, these findings indicate that extensions to medium-sized windfarms so that they are perceived as large may have significant effects on people's perception of an overbearing scale effect.

The definitions for the attribute levels from the ACBC guidance for participants may help explain the unexpected differences of part-worth utility scores between the small, medium and large-sized windfarms. This indicates that the small difference in score between the small and medium-sized windfarm reflects that both these sizes are seen as not extensive and are contained within a single landscape type, despite varying in their complexity of collective form. In contrast, the greater difference between the medium and large-sized windfarm suggests respondents placed greater importance on the larger-sized windfarm appearing extensive and to cover numerous landscape types.

To assist comprehension of how the extent of windfarms within a landscape influences perception of an overbearing scale effect, the ACBC questionnaire included a select question on cumulative effects. This question asked participants to select the point on a sliding scale at which they thought several windfarms would have a cumulative overbearing scale effect, as shown in Figure 7.29 below.

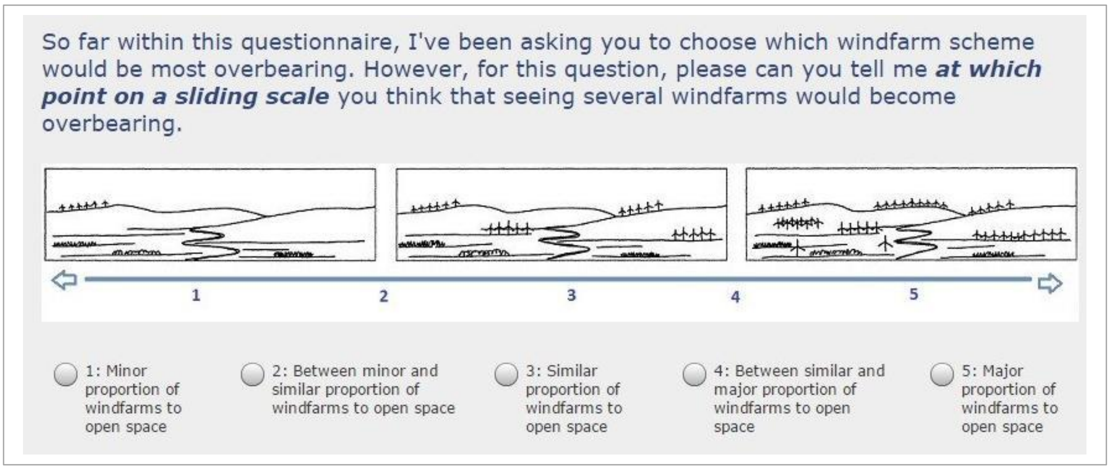



Figure 7.29: Select question within ACBC questionnaire addressing cumulative scale effect

Figure 7.30 overleaf illustrates the response data from this question. As can be seen, the majority of people (74%, *n=86*) thought that an overbearing scale effect would occur at stages 1, 2 or 3, up to the point at which there would be a 'similar proportion of windfarms to open space'.

It was found that there was a relationship between respondents' judgements and their attitudes to windfarms: of those that had a negative attitude to wind energy development, 85% selected options 1 – 3; whilst, of those that had a positive attitude to wind energy development, 67.5% selected options 1 – 3.

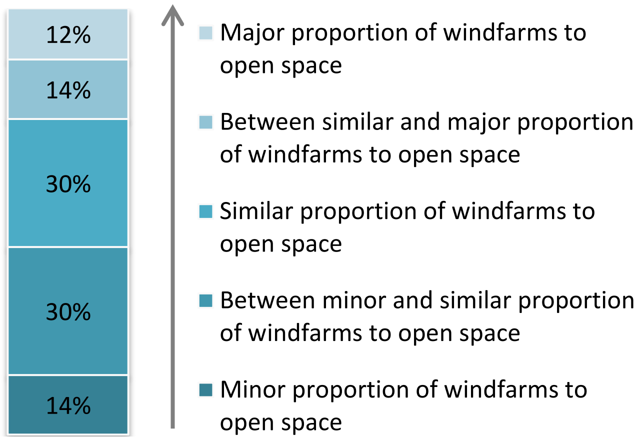



Figure 7.30: Proportion of windfarms to open space selected as resulting in an overbearing scale effect

As a select question, rather than part of the ACBC study for which trade-offs were made, limited conclusions can be drawn from the findings of this question alone. Additionally, the depiction of cumulative effects was limited within the format of the questionnaire, with neither the ability to represent panoramic views, nor the full range of windfarm type, landscape type or context of experience (including the influence of non-windfarm elements). Nonetheless, the response data confirm that the proportion of open space to development influences a judgement of a cumulative overbearing scale effect. Furthermore, correlation between responses to this question and windfarm size (shown in Appendix G.2.10) highlights the relationship between these two aspects. This supports the LVIA research findings that an overbearing scale effect was sometimes judged to come from individual windfarms, sometimes from separate groups of wind turbines within one windfarm, or sometimes from multiple windfarms.

A perception of being 'surrounded' by wind turbines is another issue of extent (by individual or numerous schemes) that was raised during the experiential landscape assessment. To explore this, the influence of windfarm distribution (concentration or dispersal) was questioned for the context of experience attribute, as discussed previously in 7.2.2.2. This is an issue that would be useful to consider further within future research.

Although the influence on scale effects of wind turbine design is not a key issue addressed by this research (explained in 3.3), the LVIA research nonetheless identified that perception of scale effect was influenced by the proportions of wind turbines, not just their overall size (described for attribute 15 in Table 5.2). To explore this further, two select questions on the preferred proportions of wind turbine blades to tower were included within the ACBC questionnaire. These were posed for two different landscape types: a moorland landscape and an agricultural or settled landscape (to distinguish differences of perceived effect in relation to scale references). As an example, the moorland question is shown below in Figure 7.31.

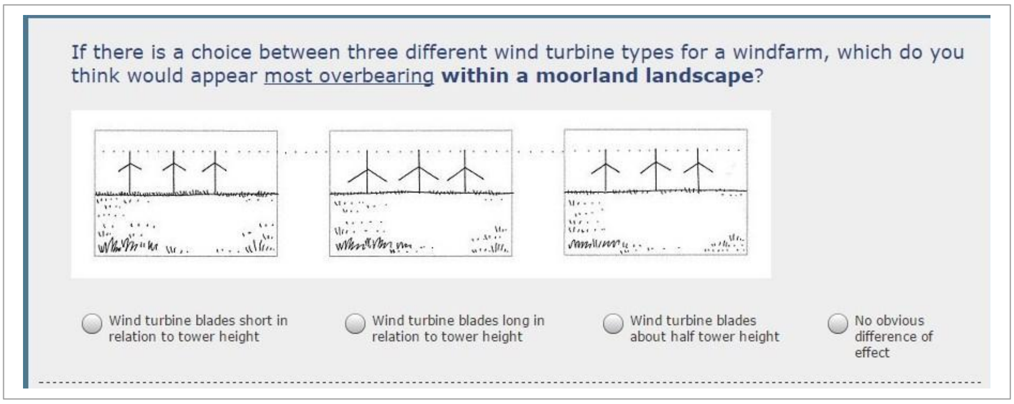



Figure 7.31: Select question within ACBC questionnaire addressing wind turbine proportion

The participant responses to the questions for wind turbine proportion are shown overleaf in Figure 7.32. This reveals that a remarkably high percentage of respondents (80.5 % average) judged that longer wind turbine blades to tower height resulted in a more overbearing scale effect in comparison to the other options of: wind turbine blades short in relation to tower height; wind turbine blades about half the tower height; or no obvious difference. This is a very important finding, as there is a current trend in Scotland for the use of wind turbines with longer wind turbine blades in proportion to towers[141] and the use of different proportioned wind turbines within a local area or for windfarm extensions.

[141] Many wind turbines with longer blades in relation to tower height were developed originally for use offshore, as a lack of ground features and thus less turbulence allowed greater efficiency at lower levels, but many wind turbines with these proportions are now being used onshore because there are great benefits of a larger 'sweep' area for energy generation.

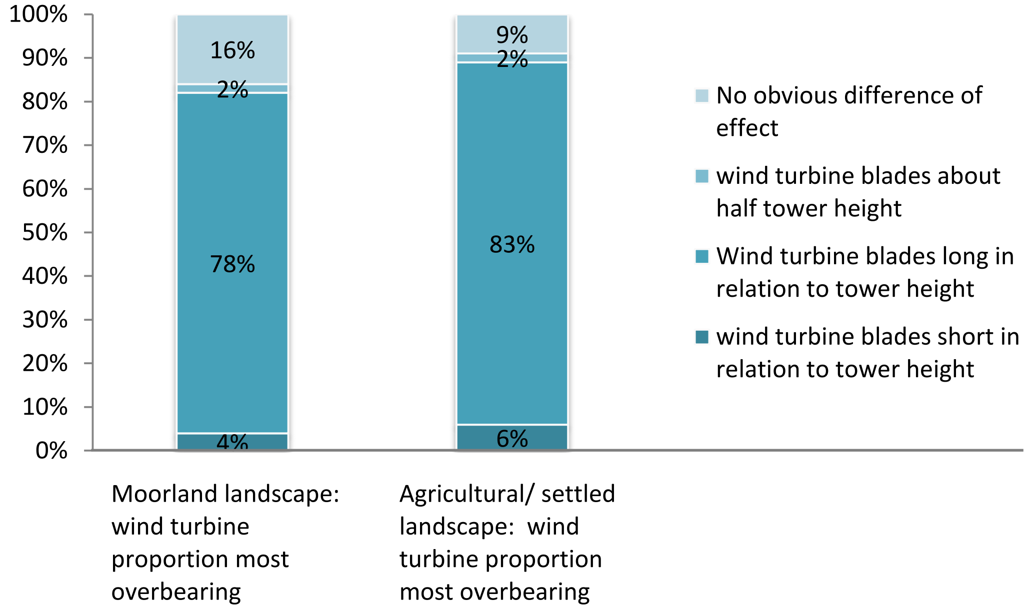



Figure 7.32: Responses on the influence of wind turbine proportion on an overbearing scale effect

The reasons why wind turbines with longer blades are judged to have a more overbearing scale effect were explored previously during the LVIA stage of the research (described in Table 5.2 of section 5.3), with key factors being the reduced perceived separation between the rotating wind turbine blades and the underlying landscape.

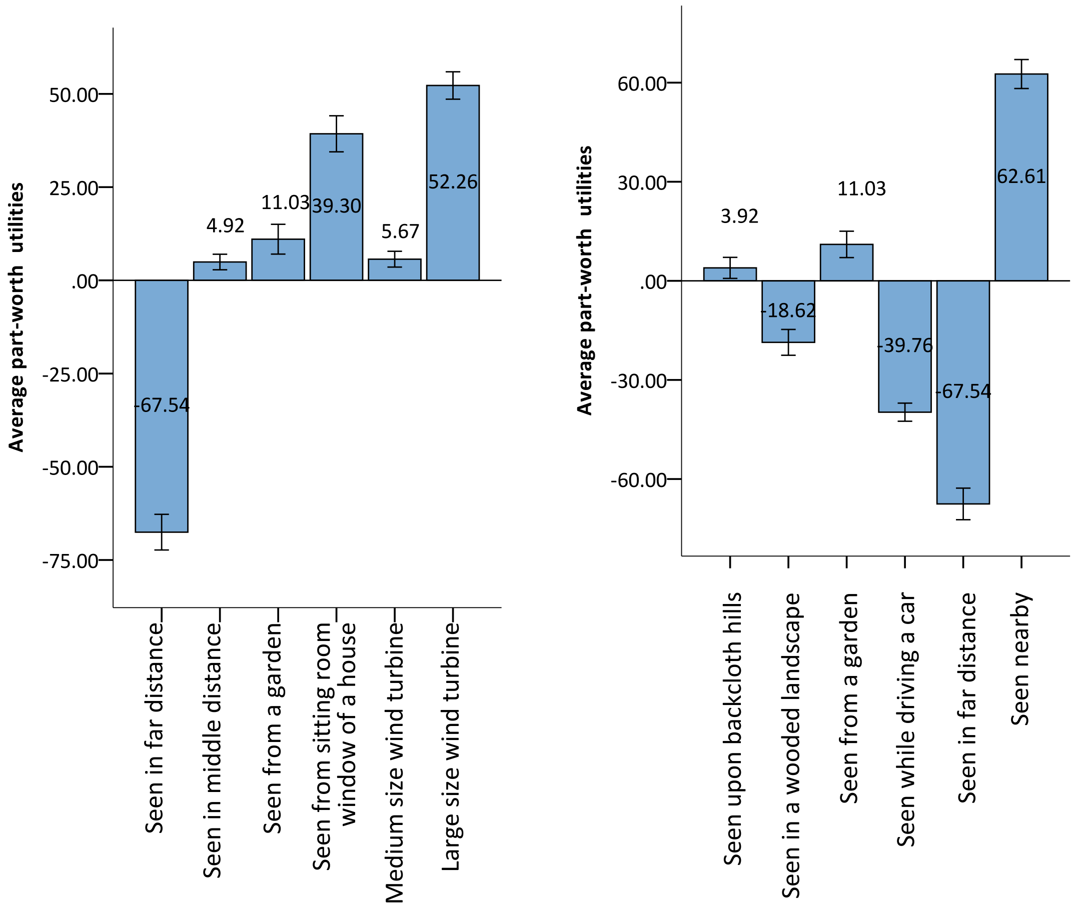
With regards to the two different landscape types, analysis of the data revealed that the majority of respondents (*n=101,* 80.5%) selected the same answer to both questions for the different landscape types, with most (*n=86, 73.5%*) selecting the second option for both: wind turbine blades long in relation to tower appearing most overbearing in scale effect. Only 8.5% of respondents (*n=10)* judged that there was no obvious difference of effect for the different proportions in both landscape types, whilst 8% of respondents (*n=9*) judged that longer wind turbine blades in relation to tower would have an overbearing scale effect within an agricultural and settled landscape, but that these proportions were not relevant within a moorland landscape.

#### 7.2.2.5 Comparison of importances across different attributes

A particular strength of Conjoint Analysis is that you can compare importances across attribute levels. As an example, this allows comparison of the average importances between medium and small-sized wind turbines (63.60) with seeing a windfarm from a house or from a local hill top (50.04), highlighting that a change of wind turbine size in this example would have greatest influence on the perception of a development having an overbearing scale effect. Table 7.8 overleaf ranks the different ranges of average importances between single levels of different attributes (attributes shown by different colours). It is highlighted that the measures are relative, not absolute; nonetheless, the data in the table not only reveal the relative importance of the different attributes and levels of attributes, but also the relative gains or losses from siting and/or designing a windfarm in different ways to reduce the perception of an overbearing scale effect.

| Table 7.8: Range of average importances between different attributes and their levels | | | |
|---|---|---|---|
| *Rank* | *Change between attribute levels* | *No of ordinal level changes* | *Difference of importance* |
| 1 | Proximity: middle distance - far distance | 1 | 72.46 |
| 2 | Size of wind turbine(s): medium - small | 1 | 63.60 |
| 3 | Proximity: nearby - middle distance | 1 | 57.69 |
| 4 | Context of experience: seen from garden - seen while driving car | 0 | 50.79 |
| 5 | Context of experience: seen from house - seen from local hill top | 0 | 50.04 |
| 6 | Size of wind turbine(s): large - medium | 1 | 46.59 |
| 7 | Windfarm size: small - single wind turbine | 1 | 46.39 |
| 8 | Windfarm size: large - medium | 1 | 41.78 |
| 9 | Context of experience: seen on local, lowland walk - seen while driving car | 0 | 39.93 |
| 10 | Context of experience: seen from house - seen on local, lowland walk | 0 | 39.13 |
| 11 | Context of experience: seen from local hill top - seen while driving car | 0 | 29.02 |
| 12 | Landscape type: seen in agricultural & settled landscape - wooded landscape | 0 | 28.66 |
| 13 | Context of experience: seen from house - seen from garden | 0 | 28.27 |
| 14 | Windfarm size: medium - small cluster | 1 | 26.96 |
| 15 | Landscape type: seen in moorland landscape - wooded landscape | 0 | 23.28 |
| 16 | Landscape type: seen on backcloth hills above mixed landscape - seen in wooded landscape | 0 | 22.54 |
| 17 | Context of experience: seen from garden - seen from local hill top | 0 | 21.77 |
| 18 | Context of experience: seen on local, lowland walk - seen from local hill top | 0 | 10.91 |
| 19 | Context of experience: seen from garden - seen on local, lowland walk | 0 | 10.86 |
| 20 | Landscape type: seen in agricultural & settled landscape - backcloth hills above mixed landscape | 0 | 6.12 |
| 21 | Landscape type: seen in agricultural & settled landscape - moorland landscape | 0 | 5.38 |
| 22 | Landscape type: seen in moorland landscape - backcloth hills above mixed landscape | 0 | 0.74 |

Numerous comparisons between attributes and part-worth utilities can be made from the data shown in Table 7.8 above, not only considering variations between single levels of the attributes, but also over more than one level (for example, between a small and large windfarm over two levels equals a difference of 46.59+63.60=110.19). For any particular windfarm proposal, it is likely that some options for variation will be more relevant than others in relation to the scope of a specific project. For example, for one scheme, it may be possible to move wind turbines within a large site boundary so that they are seen from local houses within the far distance of views, rather than in the middle distance (72.46); or perhaps the only change possible is to shift wind turbines so that they are no longer seen from inside local houses, although they can still be seen from local gardens (28.27); or, instead, an option is to change the size of the wind turbines from being large in the medium distance to being small (46.59). Figure 7.33 below illustrates graphically this and another example, showing how options can be compared side-by-side for different proposals. It can be seen that analysis of alternatives could be very useful when siting and designing a windfarm, helping to minimise overbearing scale effects. For this reason, this approach is discussed further within chapter 8 on research interpretation and application.




| *Example 1: Potential siting and design options* | *Example 2: Potential siting and design options* |
|---|---|
| • Amend to being seen in far distance rather than middle distance (72.46)<br>• Amend to being seen from just local gardens rather than from the inside of houses (28.27)<br>• Amend to using medium-sized wind turbines from large size wind turbines (46.59) | • Amend to being seen upon backcloth hills rather than within a wooded landscape (-22.54)<br>• Amend to being seen from local gardens rather than while driving a car along local roads (-50.79)<br>• Amend to being seen in the far distance rather than nearby (130.15) |

Figure 7.33: Comparison between different ranges of part-worth utilities for different attributes as could be considered for specific windfarm proposals

### *7.2.3 Analysis of the ACBC Build Your Own (BYO) and screening exercises*

The Build Your Own (BYO) section of the ACBC questionnaire asked participants at an early stage to select within which context of experience and landscape type they thought a windfarm would be most likely to have an overbearing scale effect. In addition, the subsequent screening exercise asked respondents to identify their thresholds of an overbearing scale effect by indicating the levels of attributes that were 'must haves' or 'unacceptables'. The data from these methods were analysed, including comparison between the BYO returns and the part-worth utility scores to reveal the differences between how respondents judged 'up front' the likelihood of an overbearing scale effect, in contrast to their actual judgements of importances revealed through ACBC trade-offs. The following section summarises the main findings of this analysis, with further information provided in Appendix G.3.

Through data analysis, it was found that the ranking of the different levels for the context of experience attribute were the same for the BYO as for the choice-based questions (from highest to lowest: seen from the window of a sitting room within a house; seen from a garden; seen while on a local, lowland walk; seen from a local hill-top; and seen while driving a car). Nonetheless, once trade-offs had been made by participants through the choice-based questions, greater discrimination was shown for the three middle levels, as shown in Figure 7.34 overleaf, highlighting a particular value of Conjoint Analysis to draw out these differences.

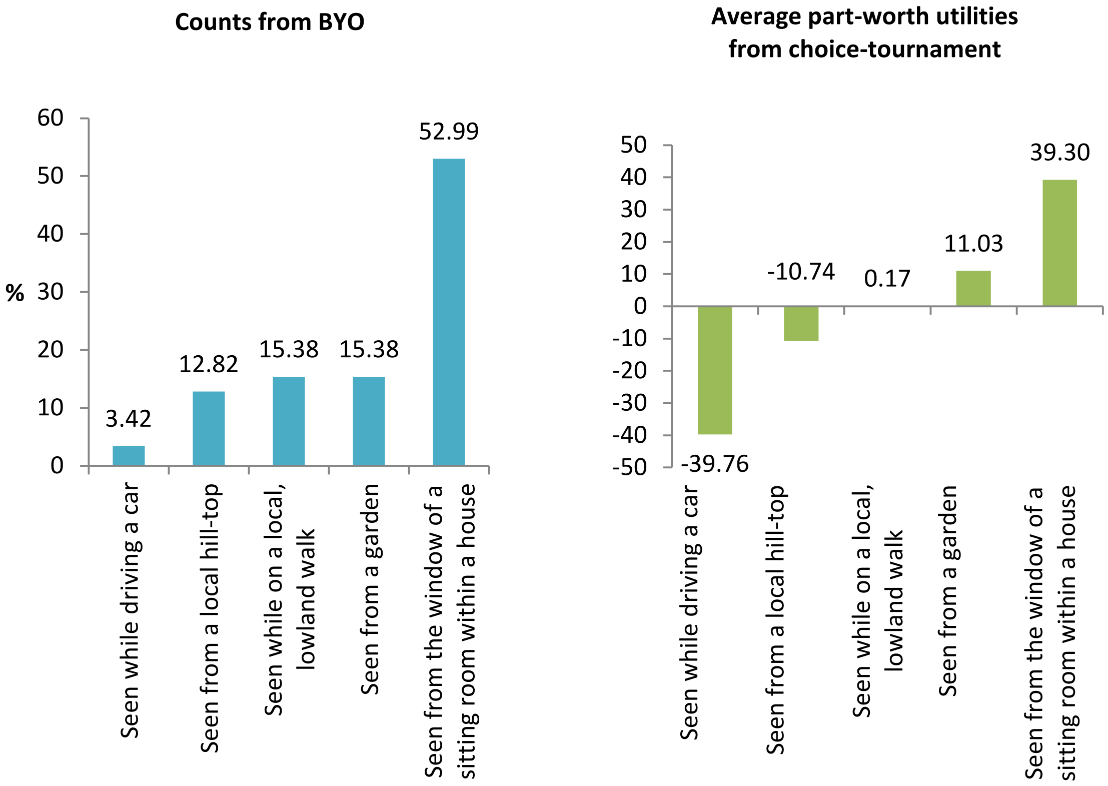



Figure 7.34: Comparison between preferences for context of experience attribute levels revealed by the BYO and choice tournament

For the landscape type attribute, once again, the ranking of the levels was the same from the BYO and choice-based questions (from highest to lowest: seen in an agricultural and settled landscape; seen in a moorland landscape; seen upon backcloth hills above a mixed landscape pattern; and seen in a wooded landscape). For this attribute, though, there was no significant greater discrimination between the levels revealed by the choice-based responses. It is not clear why there was greater difference for the context of experience ranking than the landscape type ranking, but one possibility could be that participants were more familiar with the landscape categorisation, and thus could predict earlier and more easily the contribution of this to a windfarm creating an overbearing scale effect.

The screening exercise for the research resulted in only a small number of 'must haves' (*n=9*) (Figure G.3.1 of Appendix G.3), which means that no conclusions could be drawn from the numbers themselves. Rather, the main finding from this analysis was how difficult it can be to identify individual attributes that are *always required* to have an overbearing scale effect when this can occur under many different circumstances. For example, it is difficult to say that a particular size of wind turbine is always required to create an overbearing scale effect when the threshold for this varies greatly depending on the landscape and experiential context. This supports the findings of the other research methods, including consultation through the experiential landscape assessment. It also explains why it can be difficult to identify different categories of development type in combination with landscape sensitivity for strategic capacity studies.

In contrast to the 'must have' choices, a much larger number of 'unacceptables' (*n=145*) were selected during the screening exercise (shown in Table G.3.2 of Appendix G.3). It is reminded that the term 'unacceptables' for this ACBC study is awkward because of including a double-negative: these being participants' choices of attribute levels that *mean a windfarm avoids being overbearing*[142]. The larger number of 'unacceptables' selected for this study in comparison to the 'must haves' indicates that people found it easier to identify what was not required to create an overbearing scale effect rather than what was required. Analysis of the data revealed that the attribute levels identified as likely to make a windfarm appear not overbearing were those that involved seeing the development whilst moving (*n=18*), from an open and elevated location (*n=10*), or within a wooded landscape or upon hills (each *n=6*). Predictably, the levels also included where a windfarm was small (*n=22*), at a far distance (*n=40*) and comprising a single wind turbine (*n=19*). Comparison between the 'unacceptables' selected through the screening process and the lowest part-worth utility scores revealed close alignment between these. For example, the highest number of unacceptables for the context of experience attribute were selected for 'seen while driving a car' (*n=18*) which also had the lowest part-worth utility score.

Although it had been hoped that the ACBC 'must haves' and 'unacceptables' would allow identification of thresholds of scale effect, the numbers of these selected by participants for this research were too small to indicate very clear divisions. Nonetheless, there was high consistency in the choices of 'unacceptables' which suggest that people did recognise a notable difference of overbearing scale effect above the attribute levels listed below:

[142] Further information is provided in Appendix D.9.

- Seen while driving a car
- Seen from a local hill top
- Small size wind turbine
- Seen in the far distance
- Single wind turbine

The purpose of the ACBC analysis for this research was not to identify a 'winning product' (as is often required for ACBC studies used for marketing) but, alternatively, to indicate how the various attributes and their levels contributed to the perception of scale effects, helping to understand people's priorities for preferences and the trade-offs made. In addition, as highlighted previously, the 'winning' levels for the attributes of wind turbine size, proximity and windfarm size were predictable. Nonetheless, the identification of a 'winning concept' by the software was useful for identifying the combination of landscape attribute levels for which a windfarm was judged as being most likely to appear overbearing. Additionally, its confirmation of the relative importance of the windfarm attribute levels as predicted[143] was useful in verifying that the method had worked well. In this context, the 'winning concept' identified by the ACBC software was as follows:

*Windfarm most likely to result in an overbearing scale effect*

- Seen from the window of a sitting room within a house (context of experience)
- Seen in an agricultural and settled landscape (landscape type)
- Large size wind turbine (size of wind turbine(s)
- Nearby (proximity of windfarm)
- Large number of wind turbines (windfarm size)

[143] For the windfarm attributes, it was predictable that a large windfarm with large wind turbines at close proximity would have the most overbearing scale effect, as explained further in Appendix D.9.

## 7.3 Public attitude and preference study: summary

This chapter has described the research findings for the public attitude and preference study. The most important of these findings that are new, unexpected or challenge current understanding are summarised in Figure 7.35 overleaf.

**Key findings that are new, unexpected or that challenge current understanding**

**Method**

| Finding | Comment |
|---|---|
| ACBC can be used in landscape architecture to understand the **relative importance of attributes** that influence people's judgements of landscape and visual effects (which people may not be aware of) | |
| **The use of line drawings** in ACBC can help illustrate scale attributes and focus upon what is important | |
| ACBC part-worth utility scores may be used to **assist siting and design** of a development by indicating the relative benefits of options for scale effect | |

**Words**

| Finding | Comment |
|---|---|
| **Words to describe scale and scale effects** are often used ambiguously or inconsistently (by both public and professionals), but some are used more discriminatingly | 'Overbearing' is the term used in the most discriminating way for high scale effect |

**Preferences**

| Finding | Comment |
|---|---|
| Using ACBC, **proximity** was judged most important to scale effects, followed by (in order) windfarm size, wind turbine size, context of experience and landscape type | Contrary to common reference to wind turbine size as most important and to proximity infrequently. Also unexpected that the windfarm attributes were judged more important to scale effects than the landscape attributes (important to assessment of sensitivity for sensitivity studies and LVIA which often do not consider windfarm attributes in detail) |
| People's **importances identified by the ACBC were different to those described in planning responses** | Highlights that people may need assistance to understand and convey what they perceive as most important |
| High importance was confirmed for **places which are private, offer refuge and/or the location is fixed**. These may also be **collectively important to scale effects experienced within a community or wider landscape** | Contrary to common assumption that these places are important just to individuals. This is important as they are not typically considered by LVIA |
| There is **high consistency** of respondents' judgements of the **importance of attributes affecting scale, particularly landscape type and context of experience,** although there is some variation in ranking based on knowledge of and attitudes to windfarms | Contrary to common assumptions that landscape preferences are personal and highly variable |
| **Perceived spatial separation** is very important to perceived scale effect, resulting in a higher sensitivity than expected for open landscapes such as **moorland** | Contrary to common judgement that these landscapes are not sensitive to scale effects (usually made in relation to visual scale) |
| **Multiple windfarms seen in different directions have greater scale effect** than seen clustered in one direction | |
| Even if windfarms are partially screened, scale effects are **greatest when viewed from lower relative elevation** | Contrary to assumptions that partial screening of wind turbines will reduce scale effects in these locations |
| People perceive wind turbines with **longer blades in relation to tower height** to have greatest scale effect | Important as the trend in Scotland is for blades to be longer |
| People's judgements of the importance of **wind turbine size and numbers** on scale effects **are not correlated** | Important as some suggest equal design implications for fewer, larger wind turbines or more, smaller wind turbines |
| Differences of wind turbine size, numbers and proximity **do not change scale effects at a constant rate** | Highlights changes to scale result in different degrees of change to scale effects, depending on thresholds |

Figure 7.35: Public attitude and preference study: Diagrammatic summary of key findings

## Reflections on Section C: Research findings and interpretation

This section of the thesis that includes chapters 5, 6 and 7 has described the research findings of the three main methods: Landscape and Visual Impact Assessment (LVIA); experiential landscape assessment; and public attitude and preference study. The findings of the different methods have complemented each other, addressing the research questions in different ways.

The research findings described by this section have revealed how people perceive scale and scale effects in the landscape, building upon the theoretical background. They highlight the importance of assessment processes and good communication, including the need to be clear when describing scale and scale effects given the ambiguity surrounding many words for scale and because it is a relative quality.

This section has described how application of the three methods led to different findings as well as some that reiterated and confirmed others. The findings of the LVIA method revealed that this process following GLVIA can provide a good framework for assessing scale effects. Nonetheless, it also revealed that this would benefit from further guidance or direction in addition to that offered by GLVIA to address the shortcomings of LVIA reports produced in the past with respect to scale effects. To assist assessment in the future, a number of sensitivities to scale effects were identified that should be considered in LVIA, including how these are experienced by different people. Adding to the findings of the LVIA, the experiential landscape assessment revealed that this method was particularly valuable for providing additional and more in-depth understanding of what, why, where and how people experienced a landscape so that the implications of perceiving and experiencing scale effects could be understood better. The third method of public attitude and preference study included two questionnaires, the first of which clarified how people use words to describe scale effects. The second, an ACBC questionnaire, revealed people's priorities in terms of the importance of different attributes to influence scale effect, providing information that can help designers judge the relative gains or disadvantages of different windfarm siting and designs.

These findings for Section C are taken forward into the following Section D, chapter 8, to consider how they address the specific research questions and confirm the research hypotheses.  The limitations of the findings and opportunities to develop them further are also considered in addition to how they may be applied in practice and policy. Furthermore, the findings are reviewed to consider how they build-upon the theoretical background and how they contribute new knowledge and understanding.

## Section D: Research review, application and conclusions

# Chapter 8

# REVIEW OF THE RESEARCH FINDINGS, CONSIDERATION OF THEIR APPLICATION AND CONCLUSIONS

This chapter reviews and draws together the research findings in relation to the research questions and hypotheses. It also describes the limitations of the research, considers potential opportunities for further research, and describes how the findings may be applied in policy and practice. Finally, the chapter highlights how the methods and findings of this research contribute to the advancement of knowledge and understanding in its field and draws final conclusions. This information is structured as shown below.

| | |
|---|---|
| 8.1 | Building upon the theoretical background |
| 8.2 | Addressing the research questions |
| | *How do people perceive the scale effects of windfarms?*<br>• *How do different scales of windfarm in different landscapes create different scale effects?*<br>• *How can we site and design windfarms to minimise scale effects?*<br>• *How can we best assess the scale effects of windfarms in the landscape?*<br>• *How can we best communicate scale effects to different people?* |
| 8.3 | Confirmation of the hypotheses |
| 8.4 | Limitations of the study and opportunities for further research and development |
| 8.5 | Application of the research findings through practice and policy |
| 8.6 | Contribution to knowledge and understanding |
| 8.7 | Final conclusions |

The starting point for reviewing the research findings within this chapter is the problem statement raised at the beginning of this thesis: *that people find it difficult to predict and convey the scale effects of large structures proposed in a landscape.*

### 8.1 <u>Building upon the theoretical background</u>

The theoretical background to this research was drawn from a number of different disciplines including art, architecture, environmental psychology, geography and sociology in addition to landscape architecture. This provided a good foundation for the research, although it was revealed that there is little published material upon the specific subject of the perception of scale effects in the landscape. Table 2.1 (chapter 2) lists the different types of publications that informed the theoretical background to this research, comprising both academic literature and policy or guidance documents.

Regarding the perception of scale and scale effects in the landscape, it was found that existing literature on the following was particularly relevant:

- Visual perception and the relationship between what we 'see' and what we perceive;
- Learning and knowledge of scale;
- Different theories for visual perception regarding why we perceive what we do;
- Pictorial cues for scale perception (including atmospheric scattering, occlusion and linear perspective);
- Object recognition, size constancy and 'figure-ground';
- Perception of scale and distance through motion;
- Different types of scale reference, including human scale reference;
- Aesthetic proportion and mathematical systems; and
- Perception of scale using images.

Furthermore, regarding the assessment and judgement of scale effects, it was found that literature regarding the following was particularly relevant:

- Landscape assessment processes;
- Perception of overbearing scale effects;
- Symbolism;
- How scale effects are experienced, including distance, movement and elevation;
- How large structures have been designed and judged over time;
- Public attitudes to windfarms; and
- Compatibility (including judgements of being in or out of scale) and thresholds of effects.

Limitations and gaps in the theoretical background to this research are described in 2.9 of chapter 2. It was not surprising to find that the theoretical background was spread unevenly over relevant subjects but, of particular significance, was the finding that there was a great deal of material concerning vision, perception of visual scale and aesthetic proportioning, but little concerning how scale is experienced spatially and in different landscape contexts. Although some authors have explored the link between perception and scale effects in a landscape, for example Crowe (1958), Fairbrother (1970), Lynch and Hack (1984) and the University of Newcastle (2002b), their analyses preceded the present-day scale of wind turbines. Furthermore, although there has been recent exploration of scale relationships in architecture, for example as undertaken by Stamps (1994; 2000), Tavernor (2004; 2007), and Adler, Brittain-Catlin, Fontana-Giusti (2012), this work mainly explores the relationship between people and buildings and not the additional link between people, structures and the wider landscape surroundings.

An additional limitation for the theoretical background was the frequent absence of a link between academic literature and guidelines for landscape architecture practice, particularly with regards to perception of effects (also identified by Ward Thompson, 2013). Furthermore, the methods and findings of the research were often limited by the ability of participants of surveys (professionals and the public) to recognise, process and communicate issues concerning scale effects and the experience of the landscape. Finally, there has often been variation and ambiguity between the characteristics or qualities being measured through research and the use of terms to describe these, such as prominence scenic beauty or landscape value, limiting cross-comparison and their application.

These weaknesses of the theoretical background were not surprising given the difficulty of researching perception of scale in a way that both takes into account different contexts, but does not make the findings too context-dependent to be able to draw common conclusions that can be applied elsewhere. To assist this challenge, this research included a great deal more exploration than originally expected of methods to assess perception of scale effects that built upon the theoretical background and could be applied in different landscapes, rather than just trying to find answers over an infinite range of variables.

A key challenge for future application of this research is how to transfer the knowledge revealed by the literature review for this study through to those that need to be able to assess and understand the scale effects of windfarms. This is important because, in the absence of knowledge of some subjects, there may be undue reliance on those that are understood more commonly, for example focus on linear perspective without consideration of scale constancy. Furthermore, because of the complexity of LVIA and factors affecting perception and experience of a landscape, it can be tempting for some to rely on partial information for the sake of simplicity and ease. For example, some assessors judge the scale effects of a windfarm based mainly on computer generated visualisations despite acknowledging these do not convey scale effects well. This is not a new challenge and the University of Newcastle produced in 2002 a 'conceptual model for visual impact assessment' that highlighted aspects of perception that should be considered (2002b, p63). Nonetheless, given the general nature of GLVIA (2013)[144], including with regards to perception and assessing the experience of a landscape, there remains a continued need to explain further how landscape and perception theory will influence people's judgements and experience of the scale effects of windfarms in a landscape.

## 8.2 Addressing the research questions

The following section describes how the research findings have addressed the separate research questions (first identified in section 2.10).

### *8.2.1 How do people perceive the scale effects of windfarms in a landscape?*

The overarching question for this research was how do people perceive the scale effects of windfarms? In response, not surprisingly, this research has confirmed that perception of scale is a complex process. This is partly because any human perception is a mental construct and based upon the brain interpreting stimuli received through our senses (Motloch, 2001). In addition, perception is further influenced by the variability of the environment, particularly with regards to the visual and spatial characteristics of a landscape, and how these are experienced and by whom and why. Furthermore, the scale effects of windfarms vary significantly in relation to their different locations and designs.

A key challenge for understanding perception of scale in the landscape is that people often think this is automatic, but we all have to learn to interpret stimuli or data to make judgements of scale. This means that, although scale may be measured in standard units such as metres, perception of scale effects requires further interpretation.

[144] That is used by most landscape architects in Scotland to assess the landscape and visual effects of large structures.

There is a long history to the study of visual perception, with different theories for why we perceive the landscape as we do, particularly between ‘constructive’ and ‘ecological’ approaches (Bruce, Green and Georgeson, 1996). Nonetheless, most people agree that perception involves some kind of physiological processing of information, is influenced by learning, and we perceive for a reason (Aspinall, 2010b; Bell, 1999; Gregory, 1998; Heft, 2010), ie we do not perceive the world around us like an abstract image.

As the brain is selective in the information it sources and registers (Chabris and Simons, 2010; University of Newcastle, 2002b), there is an important difference between what we see and what we notice and perceive (Gregory, 1998). This is very important with regards to how we perceive the scale of windfarms because it highlights that there is a difference between how prominent or what size a windfarm may appear in a view or image and what its scale effects may be when experienced on site.

Judgement of the scale of windfarms is relative and scale references are mentioned within some LVIAs and guidance documents (for example SNH, 2014a). Nonetheless, these mainly limit information to identifying that visual scale references exist and are important. Conversely, through this research, it has been highlighted that there are two key ways in which scale is perceived within a landscape: visually and spatially, and that people’s experience of the landscape influence this perception, as shown in Figure 8.1 overleaf. In addition, this research supports the theory (identified in 2.1) that our judgement of the relative scale of an object occurs in three different ways: in relation to a total range or measure; in relation to another element (including us as humans); and in relation to what we judge as normal. Thus, when describing the perceived scale of windfarms, it is important to identify what kind of reference is being made, especially with regards to the last type as the benchmark for normality may change over time.

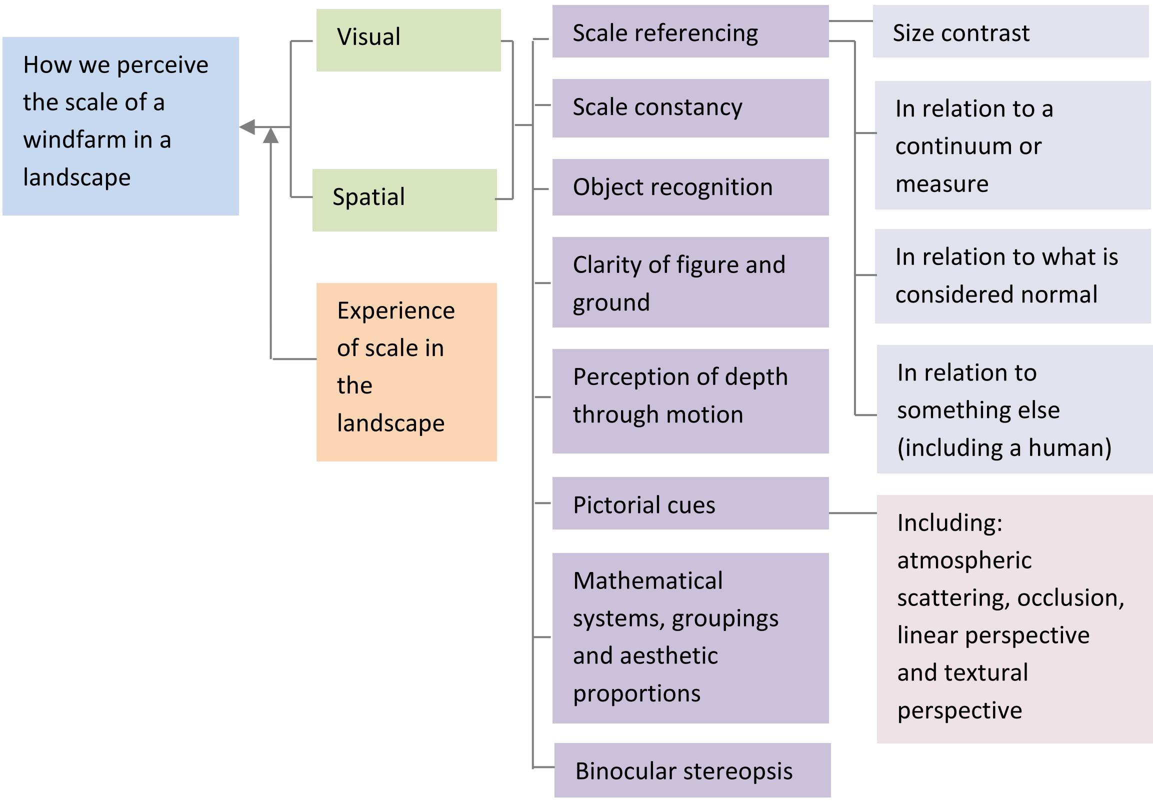



Figure 8.1: Aspects of perception found to be most influential to perception of the scale and scale effects of a windfarm in a landscape

Setting out a structure for the different ways in which we perceive scale in a landscape is important because it addresses one of the main inconsistencies identified by this research: that is, that people carrying out landscape and visual assessments[145] of windfarms and submitting planning responses mainly refer to visual scale only, and in an abstract way that does not relate to the experience of people. Conversely, people consulted through participatory consultation for this research also highlighted the importance of spatial scale sensitivities and effects, including upon them as receptors[146].

The perception of spatial scale was found to relate to the extent of spaces, their edges and what they contained, supporting published literature. Some authors have in the past tried to categorise the different scales of spaces in terms of their character or human responses, but these have not been defined consistently and typically refer to smaller scale spaces

[145] Including the broad range of assessments of this type, not necessarily LVIA
[146] Supporting the findings of other research, for example as carried out by Churchward *et al* (2013), Haggett, Coleman and Hodges (2015), The Research Box, LUC and Minter (2009).

than relevant to wind turbines. When perceiving the spatial scale effects of a windfarm, it was found that a key judgement was whether a development appeared overbearing upon the characteristics, qualities and value of the space in which it was located, the space in which the viewer was located or, alternatively, directly upon the viewer themselves.

We use different processes and cues to perceive scale. As shown in Figure 8.1, those that are most influential on our perception of the scale effects of windfarms were found to be: binocular stereopsis; pictorial cues (including atmospheric scattering, occlusion, linear perspective and textural perspective); scale constancy; object recognition; size contrast; an impression of depth from motion; figure-ground; and mathematical systems, grouping and proportions. Some of these are frequently termed 'illusions' within books and articles, as if they are the result of some kind of manipulation or mystery, but they are part of the reality of perception and thus need to be taken into account when assessing scale effects in the landscape. It is nonetheless acknowledged that this can be challenging, as all the influences on our perception are not available to us consciously and cannot be quantified.

Scale perception informed by scale reference requires a link to be made between the references. For many objects in the landscape, we use ourselves as the scale reference - 'human scale' - but this comparison is not possible for large wind turbines due to their disparity of scale. This is a difficult problem to address because, although alternative scale references may still be made between a windfarm and larger features or spaces within the surrounding landscape, for example a hill range or coastline, these references are of widely variable size and thus do not provide a standard reference. Furthermore, because of the disparity of scale between these and human scale elements, they do not help us understand the potential scale effects on us as people.

The findings of this research revealed that our perception of the scale effects of a windfarm is formed from a composite of experiences in a landscape from different places, at different times, whilst carrying out different activities. In this context, the research revealed that the everyday experience of a landscape, including journeys, was particularly important to local people, even if the landscape or the experiences were not highly remarkable. Furthermore, supporting published literature on affordances (for example Heft, 2010), people's experience of scale effects was found to be influenced by why and for what they were experiencing the landscape.

Although there are many characteristics of a landscape and visual resource and how this is experienced that influence perception of scale effects in a landscape, of particular importance was found to be the legibility of scale in the landscape and the elevation and movement of people. Legibility of scale was revealed to be strongly influenced by the type and distribution of scale references or cues, for example whether the pattern or texture of a landscape could be seen extending all the way between a viewer and a windfarm. This legibility was affected by more than just visibility, and object recognition was identified as being important, influencing the perceived scale of wind turbines even if they were not entirely visible. With regards to elevation, the perception of the scale effects of windfarms was influenced strongly in upward views by visual foreshortening, whilst downward views tend to be more extensive. In addition, the perception of distance to a development was also influenced by whether it was backclothed or skylined. Furthermore, movement through a landscape was found to assist the perception of scale effects by indicating distance through motion parallax and by providing a better understanding of the scale context in which a development was located by providing multiple cues.

Our preferences for certain aesthetic proportions following mathematical systems have been explored over many centuries. Most proportion systems are based on numerical patterns which have been linked to a perception of harmony, with one of the most well-known being the Golden Section. Although this research has not explored in detail preferences for specific proportions with regards to windfarm scale effect, the research findings support generally existing literature on people's preference for certain scale proportions, whether these are conscious or not. Ching (1996, p284) highlights that '… *the visual order they create can be sensed, accepted or even recognized partly through a series of repetitive experiences'*. Nonetheless, the research findings also support the theory of abstraction proposed by van der Laan (Padovan, 1999). This states that our preferences for certain scale relationships are influenced by our wish to rationalise relationships within the continuum of scale and that we group elements of similar scale which, in turn, influences perceived compatibility and thresholds of effect.

When judging the scale effects of windfarms, the findings of this research supported published literature that describes how two-dimensional images cannot represent well perception of scale in a landscape. Artists have been long aware of this limitation and have deployed different methods over time to try to add 'depth' to a view, for example amplifying the apparent contrast in light, colour and texture between the fore, mid and background, but this cannot be conveyed similarly in photographs. This research confirms that it is always advisable to make accurate judgements of the perception of the scale effects of windfarms whilst on site. Furthermore, when looking at photographs, it is important to recognise that the size of wind turbines shown will represent linear perspective, but not other influences on our perception of scale, as shown in Figure 8.1, such as size constancy and motion parallax.

Our perception of the scale effects of windfarms is also influenced by the symbolism of these and the landscapes in which they are situated. Symbols are social creations and thus influenced by cultural, historical and social factors which may change over time. They are thus complex to understand and, it has been argued, even more so for windfarms which are a relatively recent development type, so society has yet to place them clearly within historical, cultural and social context (Brittan, 2002b; Hough, 1990; Selman, 2010). Many authors have highlighted that large scale structures are often perceived to symbolise great strength, importance, wealth or power (for example: Bell, 2004; Crowe, 1958; Tavernor, 2004), whilst others have suggested that windfarms could be compared with land art which is valued for its positive symbolism.

The acceptability of the perceived scale effects of a windfarm is often judged in relation to whether it appears 'in scale' or 'out of scale'. This is a difficult judgement to make given explicit criteria are rarely provided. During this research, it was found that aims to be in or out of scale seemed to relate most closely to judged compatibility, but this is not straightforward to achieve for windfarms if these are disparate in scale to other built elements in a landscape. This research has highlighted that judging compatibility of windfarms is a key challenge that has not yet been addressed by landscape architects in practice or by published guidelines or planning policy. To date, there has been casual adoption of an aim for compatibility similar to how this has been used for much smaller objects in our landscape, but without adequate questioning of whether compatibility of large windfarms is even possible. So far, addressing this challenge seems to have been avoided by selecting larger and larger elements of a landscape with which it is claimed a windfarm is compatible (possible because compatibility can occur at various levels). Nonetheless, this ignores how people perceive scale effects. That is, although a windfarm may be compatible with one landscape characteristic, such as a large hill range or coastline, if it is incompatible with adjacent landscape characteristics, such as within a settlement, it will be incompatible with the experience and qualities of scale experienced by people within the landscape.

### *8.2.2 How do different scales of windfarm in different landscapes create different scale effects? How can we site and design windfarms to minimise scale effects?*

The two research questions labelled above are closely related, with the first informing the second. The research questions are addressed largely by the findings of the LVIA, experiential landscape assessment and ACBC which identify a large number of landscape and windfarm attributes that influence scale effects.

During the early stages of the research, it had been envisaged that there might be a direct relationship between landscape type and wind turbine size in leading to different levels of scale effect (to the extent that you might show scale effect plotted against landscape type and wind turbine size as mocked-up in Figure H.1.1 of Appendix H.1). This was not an unreasonable expectation given that many capacity studies for windfarms are produced on this basis. Nonetheless, it became apparent very quickly during the research that, although there are some common scale effects that result from combining certain landscape and windfarm attributes, these are influenced significantly by perception of scale and the variables of how a landscape is experienced.

Considering how different scales of windfarm in different landscapes create different scale effects, the research findings can be grouped into four categories: spatial characteristics and experience of the landscape; windfarm attributes; legibility of the landscape scale and landscape pattern; and landscape type. These are shown in Table 8.1 overleaf, together with reference to where they are described in detail within the thesis report. Some of the attributes found to influence scale effect were not surprising, for example landscape pattern, as these had been identified previously in published literature, but the strong influence of other attributes was less expected, such as spatial separation and landform edges. Furthermore, the research confirmed that there was not a direct relationship between some of the attributes in terms of their influence on perceived scale effect as had been expected, such as between wind turbine size and windfarm size, and the research highlighted that there were unequal thresholds of different scale effects.

| Table 8.1: Categories of research findings relevant to how different scales of windfarms within different landscapes create different scale effects. | | |
|---|---|---|
| *Category* | *Reference to section within thesis* | |
| | *Chapter* | *Page(s)* |
| **Spatial characteristics and experience of the landscape** | | |
| Activity of people within the landscape | 6 | 158-160 |
| Context of landscape experience | 7 | 194-201 |
| Distance, access and vantage points | 5 | 132-133 |
| Distribution and relationship between landscape character, settlements, residences and routes from which the landscape is experienced | 6 | 156-158 |
| Influence of elevation of viewpoint on scale estimation and effects | 5 | 133-134 |
| Perceived scale of extent of a landscape | 5 | 134-135 |
| Relationship between windfarm and the scale of spaces and people | 5 | 132 |
| Scale of landform edge | 5 | 134 |
| Spatial characteristics and the experience of these | 6 | 163-167 |
| **Legibility of the landscape scale and landscape pattern** | | |
| Landscape pattern and cues for perceiving distance | 5 | 135-136 |
| Influence of landform or woodland on the visible scale of wind turbines | 5 | 138 |
| Relationship between windfarms and the scale and screening of woodland | 5 | 136-137 |
| The influence of landscape pattern on scale indication and perception of an overbearing scale effect | 5 | 137-138 |
| Visibility, legibility and references within the landscape | 6 | 160-163 |
| Visual relationship to the landform skyline | 5 | 136 |
| **Landscape type** | | |
| Landscape type | 7 | 201-206 |
| Pattern of large scale features | 5 | 140-141 |
| Relationship between wind turbines and other vertical features | 5 | 140 |
| Shape and scale of the landform | 5 | 141-143 |
| Varying relationship to landscape characteristics and landscape character type | 5 | 139-140 |
| **Windfarm type** | | |
| Extent of windfarm | 5 | 146 |
| Variation of wind turbine size | 5 | 145 |
| Windfarm proximity, windfarm size and size of wind turbines | 7 | 206-217 |
| Wind turbine orientation, lighting and colour | 5 | 146 |
| Wind turbine proportion | 5 | 143-145 |

To address the second research question, how to site and design windfarms to minimise scale effects, it is important to appreciate that there is no 'true solution' and that many options may be acceptable (Prominski, 2012). What is more important is to consider alternatives and the most suitable solution in relation to the specific sensitivities of the landscape perceived by people.

In addition to the findings listed in Table 8.1 above, it is possible to use the findings of the ACBC study to understand the relative importances of different attributes and their levels to influence perception of scale effect. Reference can be made to the differences between the part-worth utilities, as shown in Table 7.8 of chapter 7, to inform the siting and design process of a windfarm development, although the scope for alternatives will differ between different schemes. As an example (in reference to Table 7.8), more would be gained in terms of reducing perceived overbearing scale effect from changing a proposed windfarm from medium to small-sized wind turbines (63.60) than changing its siting so that it is only seen from a local hill top rather than from local houses (50.04).

To assist consideration of all the issues important to the siting and design of a windfarm to minimise scale effects, a provisional prompt list was developed (Appendix H.5, Table H.5.1). This remains provisional because it has not been tested in practice and may require further development, but it does demonstrate how the research findings (cross referenced to sections of the thesis) may be used in the future and it provides a start point for further development of the findings.

Although the prompt list for siting and design may be useful for providing a framework for assessment, a key issue raised throughout this research was the need to consider sensitivities to scale in combination as well as separately. In this regard, the findings of the experiential landscape assessment and public attitude and preference study are important in highlighting how different attributes and effects are experienced together.

### *8.2.3 How can we best assess the scale effects of windfarms in the landscape? How can we best communicate scale effects to different people?*

The following section addresses the two research questions labelled above, which are considered together because of the strong link found between communication and assessment processes.

During the EIA process, developers of windfarms and other major applications often present the interim findings of professional assessments to communities at some kind of public exhibition, but do not typically embrace the fact that they can also gain a great deal of information from communities through consultation that can assist the EIA. This two-way communication can also help greatly to identify and focus upon what is most important. Although EIA scoping should also provide a conduit for this kind of information, it was found at an early stage of this research that people did not usually convey all the information that would be useful through written responses to consultations such as EIA scoping. Conversely, it was revealed that much more detailed and relevant information could be gained through participatory consultation, supporting the findings of other studies such as Churchward *et al* (2013), Haggett, Coleman and Hodges (2015) and The Research Box, LUC and Minter (2009). This process of communication may assist not only the design and assessment process for a development, but can also help to address the 'social gap' (described in 2.7) by revealing the concerns of qualified supporters.

#### 8.2.3.1 A method of assessment for the future

The method developed for this research combined LVIA, experiential landscape assessment and public attitude and preference study. Building upon the advantages and disadvantages identified for each of these methods in addition to the findings of this research, the following section of this chapter will consider how the scale effects of windfarms could be best assessed in the future.

As the findings of an experiential landscape assessment overlap with those of a LVIA (following GLVIA), a key question is whether assessment of scale effects and the experience of these in a landscape could be achieved best through a LVIA (that is thorough and includes assessment of experiential aspects) or both a LVIA and a separate experiential landscape assessment. A key consideration for this is their difference of underlying approach: the focus of LVIA being on a proposed development, and the focus of experiential landscape assessment being on the relationship between landscape and people.

There are a number of advantages and disadvantages of combining or keeping separate the methods of LVIA and experiential landscape assessment in the future. One benefit of combining these is to avoid the addition of another assessment process to EIA and avoid separating the assessment of the experience of the landscape from other landscape and visual aspects. Nonetheless, a disadvantage of a combined assessment is that this does not highlight the particular importance of the experience of a landscape and the relationship between people and the landscape[147]. On reflection, considering these alternatives, it can be seen that it is not really important *per se* whether the assessment processes of LVIA and experiential landscape assessment are carried out separately or in combination, as long as the essential aspects of both assessment processes are included. This will be important to clarify and confirm as part of scoping for an EIA.

### *Use of LVIA*

LVIA is a useful method for offering a clear structure by which to assess the sensitivity of a landscape and visual resource to a proposed development and the magnitude and significance of effects. Nonetheless, this research highlighted that the method and execution of LVIA in practice results in common shortcomings with regards to scale effects (described in 5.2).

To consider how LVIA following the third edition of GLVIA provides scope in the future to assess scale effects and the experience of these in a landscape, this research carried out a review of GLVIA3, as described by chapter 5 and summarised in Table E.1.2 of Appendix E.1. This confirmed that GLVIA3 provides useful guidance to steer LVIA which, in turn, offers sufficient scope for the assessment of scale effects and how these are experienced in the landscape, addressing the sensitivities to scale effect identified in section 5.3 as being necessary to consider. Furthermore, it addresses some of the shortcomings of GLVIA2. Nonetheless, it also shares a number of its limitations that require address and would benefit from additional guidance or clarification, as listed below:

- Clarification of wording with regards to describing scale in different ways, for example as a characteristic or as a level of magnitude;

[147] Separate assessment processes was the approach adopted by 'The Missing Chapter' project (Haggett, Coleman and Hodges, 2015), for which it was decided that the inadequacy of current assessment of people and place meant it would be best to assess this within a separate and additional chapter of EIA

- Additional guidance regarding the need for different information on issues such as scale for different users;
- Provision of additional examples of how scale effects should be assessed qualitatively (most existing examples being quantitative);
- Additional guidance on the role, requirements and gains of consultation with local people, avoiding an over-reliance on sensitivities being raised through EIA scoping[148];
- Additional guidance on the methods to obtain information on how a landscape is experienced and valued, including the use of participatory consultation;
- Additional guidance on how to judge the positive effects of 'good design' if this is incompatible with the baseline conditions (for example if a proposal is 'out of scale');
- Additional guidance on how to judge the combined effects of a proposal including scale effects (to avoid assessors 'averaging' effects and to recognise the relative importance of different effects); and
- Additional guidance on how to judge levels of effect in-between either ends of a spectrum and how to identify thresholds of scale effect.

A requirement of LVIA which often proves challenging is the division between the landscape and visual resource as well as landscape and visual effects, although the distinction between these is clearly defined within GLVIA3. This challenge is raised when assessing scale effects and the experience of these, as they relate to both the landscape and visual resource. For example, there are visual scale effects which you would expect to be considered by the VIA and spatial scale effects that you would expect to be considered by the LIA, and both are experienced visually and in relation to the character of the landscape. This is not an unusual situation, with other common subjects of LVIA including both aspects, such as sequential assessment along key routes, and these can be navigated if explained and signposted clearly. Nonetheless, either splitting an assessment of scale effects and the experience of these between the VIA and LIA or taking these out to form a separate section have disadvantages in terms of fragmentation and considering effects out

[148] Based on the findings of the review of responses and representations to planning applications carried out for this research

of context. This is thus an issue that would benefit from additional exploration in the future, as described in section 8.4.

Although GLVIA3 mentions that it is important to consider the experience of a landscape, the review of existing LVIA reports in comparison to the information gained through this research indicates that GLVIA is not providing sufficient guidance to steer assessors through this process. Additional exploration of this subject would be beneficial, as identified in section 8.4. Nonetheless, a provisional prompt list for the assessment of sensitivities to scale including the experience of the landscape has been developed that draws on the findings of this research, as included in Appendix H.7 (Table H.7.1). This remains provisional because it has not been tested in practice, but it demonstrates how the research findings may be developed further and used in the future.

### *Consultation and participation as part of the assessment process*

There is widespread support for consultation during the planning process by the Scottish Government and public sector organisations as well as academics and consultants in practice. Nonetheless, although public consultation is a key requirement of a planning application for a major development such as a large windfarm, for many projects this involves mainly exhibiting extracts from a draft EIA report. This is quite different to public participation which involves engaging people in a project (Jones and Eiser, 2010). In addition, conventional public consultation is often limited to inviting opinion on the potential effects of a development, but does not usually invite people to identify and explain the sensitivities of the landscape and visual resource and how they experience and value this which should inform siting and design (Churchward *et al*, 2013).

The findings of this research have highlighted the great value of consultation with local people, including both professionals and members of the public. As described previously in chapter 6, whilst most of the scale issues raised during the semi-structured interviews for this research had been identified previously through the researcher's professional landscape architecture assessment, the participatory consultation revealed much more clearly how, for what and why people experienced and valued different aspects of the landscape relevant to scale effects. In addition, clearer understanding was gained on the relative importances of different attributes of both the landscape and development type to influence people's perception of scale effect. Following these findings, a key challenge is to consider how the benefits of this type of process and involvement could be achieved in the future through mainstream development of planning proposals.

Running consultation exercises not only requires a great deal of time and organisation, but this research found that, to obtain the most useful information from participants, it also required a significant amount of facilitation. For example, it is not useful to just ask people how they experience their landscape; not because people do not know this information, but because the answer to this question may not be readily available to them because they have not analysed previously the whats, whys and hows regarding their perceptions and values of their environment. Alternatively, questions such as that stated above need to be followed by further guidance to make the enquiry relevant to the individual participant, for example asking where they tend to go when walking their dog or going for a trip out with their children on a sunny day.

Exploring further the scope for consultation and the resource implications, a key issue is the most appropriate extent of any study area. The LVIAs for most windfarms have a study area of 35km radius[149] whilst, in contrast, projects such as 'The Missing Chapter' have focused upon a very small study area[150] in great detail. During early stages of this research, it was envisaged that the most appropriate study area might be something in-between, such as 5 or 10km. Nonetheless, after early assessment on site and consultation, it became clear that the study area needed to relate to the places from which there was likely to be significant scale effects on the experience of the landscape by both the community of place and interest[151] and this was not the same extent for different study areas and was not circular in shape (as shown by the maps of the study areas included in Appendix C.1).

Following the findings of this research, provisional notes were developed for planning an experiential landscape assessment of scale effects involving both consultation and professional assessment, included in Appendix H.6 (Table H.6.1). These notes are only provisional because they have not been tested in practice and may require further development. Nonetheless, they demonstrate how the findings of this research may be

[149] Refer to section 3.2 of chapter 3
[150] Approximately $3km^2$
[151] Described in Topic Paper 6 produced by SNH and the Countryside Agency (2002c)

able to be applied in the future to assist assessment of how a landscape is experienced and sensitivities to scale effects. In addition, they provide a base from which to carry out additional research in the future, as described in section 8.4.

### *Assessing public preferences*

The findings of the ACBC analysis carried out for this research identified the relative importances of five different attributes and their different levels on perceived scale effect: landscape type; context of experience; windfarm proximity; wind turbine size; and windfarm size. Although there were limitations to the method of this study, its findings can be applied when assessing the scale effects of windfarms, as they indicate which attributes and levels are most influential on people's perception of an overbearing scale effect. Table 7.8 of chapter 7 lists the differences between the part-worth utility scores of the attributes and the different levels which indicate the relative benefits of modifying a windfarm scheme in terms of the likely resultant scale effects. For example, it shows the difference that would occur if changing a scheme from being seen in the middle-distance to the far distance (72.46) in contrast to modifying it to use large scale wind turbines rather than medium scale wind turbines (46.59).

Building upon the findings of the ACBC study for this research, it may be useful to run additional ACBC questionnaires for specific windfarm proposals. This would allow a number of different or additional attributes to be included that may be important within a particular area, for example additional levels of windfarm size or landscape types, or the inclusion of some of the attributes that were excluded from this study (summarised within the review in Table D.8.1 of Appendix D.8). It could also confirm variations in the relative importances of the attributes within other study areas.

A key finding of the ACBC study (supporting the findings of the experiential landscape assessment) was the relatively high importance of two levels of the context of experience attribute that are often not considered as part of conventional LVIA or EIA: views from houses and gardens. Whilst LVIA does not assess individuals as visual receptors[152], the frequency and consistency with which these attribute levels were raised during both the

[152] EIA and LVIA are concerned with 'social views', assessing effects at the community level, and not individual's views according to Mary O'Connor at Landscape Institute GLVIA training [personal communication, 13 January 2016].

ACBC study and experiential landscape assessment indicate that their collective sensitivity within communities should be assessed, as too should the scale effects[153] of a development upon these receptors.

*Other assessment methods*

In addition to the three methods used for this research, there may be other methods that could also be applied or developed in the future for the assessment of scale effects and the experience of the landscape. One method that has become increasingly popular in recent years has been 'residential visual amenity assessment' which may have some relevance to further development of this research, as summarised in Appendix H.3, although GLVIA confirms that this method should not be considered part of LVIA.

#### 8.2.3.2 Communication

It was revealed throughout this research that communication is a key issue with regards to scale and scale effects in a landscape. At an early stage, it was found that relying on a description of the scale of a wind turbine in terms of dimensions for height and distance was not helpful as people's observation of the scale effects of a windfarm did not match with their estimation of height and distance (Appendix A.5). In addition, it was revealed that it was difficult for some people to find the words to describe their perception of scale effects and, furthermore, many of the words used by people to describe scale were ambiguous or not defined clearly or consistently.

Comparison between the words used to describe scale made by professionals within LVIAs and by members of the public during consultation for the experiential landscape assessment found that these tended to differ. Nonetheless, subsequent review of the different words and the predicted effects revealed that there was often very little difference between the scale effects being described; rather, people were using different words in different ways to describe the same effects and also members of the public tended to include reference to how they experienced the effects, not just what the effects were. This is illustrated in the example in Figure 8.2 overleaf, with typical words used in LVIA to describe scale shown in the left hand column and some examples of words used by members of the public shown in the right hand column. The challenge with regards to

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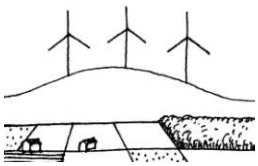
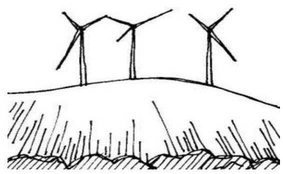
[153] And other landscape and visual effects.

better communication in the future is to bridge the gap so we are ‘speaking the same language’ and/or understanding each other.





| **Individual aspects of scale identified within LVIA** | | **Description of scale effects by members of the local community, indicating the experience of these** |
|---|---|---|
| For example:<br>• The wind turbines will appear large in relation to the hill landform, landscape pattern and buildings.<br>• The wind turbines will be elevated upon the hill top.<br>• The wind turbines will occupy a large proportion of the open space. | *Scope to have common understanding and description of scale effects* | For example (from case study participants):<br>• *‘They will appear to ‘hover’ above us’*<br>• *‘People don’t like large structures above them. They are threatening’*<br>• *‘They would be better if located further back… seeing less up front, so they seem more distant’* |

Figure 8.2: Different ways of describing the same scale effects

Good communication is a two-way process (as described in the previous section on consultation) and thus it is not only important for professionals to communicate well in their descriptions of scale and scale effects, but also to facilitate others being able to communicate their own perceptions and judgements back to them. In addition, good communication is not just important for clarity, but can help people understand concepts more clearly. Furthermore, this research found during the semi-structured interviews for the experiential landscape assessment that giving people the tools to convey better the nature of landscape and visual effects can help them gain confidence to contribute more.

Through this research, a number of key issues were identified with regards to communicating scale effects as summarised below:

a Many people (both professionals and the public) find it easier to describe the scale of a landscape verbally than in writing (possibly because of the need to define or qualify terms), and this is also easier on site where references can be viewed.

b It is important to use words precisely to describe scale and to define what these mean. As the scale of something is a relative judgement, it is important to describe the reference being made, particularly whether it is made in relation to an overall range, another element, or what is considered normal (all of which also need to be qualified).

c Scale effects need to be described in terms of the actual effect as would be perceived by a person, not just the dimensions of size or distance influencing this effect. It needs to be clear whether the effect relates to visual scale or spatial scale and how it would be experienced.

d When describing scale effects, it is best to use words that refer to scale only and do not confuse this with other effects such as prominence or form.

e It is best to select words to describe scale effects that people use in a more discriminating way. If different words are preferred for different levels of effect, this research revealed that those used in the most discriminating way were 'overbearing' for high scale effect, 'balanced' for medium scale effect, and 'modest' for low scale effect. Nonetheless, many people were found to prefer to describe different levels of high scale effect, rather than using different words for different levels, for example describing a high, medium or low level of an overbearing scale effect.

f When describing scale or scale effect within a landscape, it is important to highlight the cues that are or would be affecting the perception of scale, as some people may not realise the influence of these and, additionally, they may change over time.

The challenge to communicate clearly is common across landscape architecture practice, not just aspects concerning scale and the experience of the landscape, as it is too an issue for some other disciplines. It is possible that this is a temporary stage, reflecting the relative youth of the landscape architecture profession in contrast to other disciplines such as architecture and engineering. Nonetheless, in the short term, to improve clarity, consistency, and confidence in the use of words to describe scale and scale effects, it may be beneficial to provide more explanation than customary for the terms used, backed-up by glossaries or lexicons.

Although this section has discussed so far the use of written or spoken words, there are also other modes of communication available. The use of images was explored during this research, including visualisations, but also the relative advantages or disadvantages of using hand-drawn line drawings or photographs, as discussed for the ACBC study (Appendix D.9). Hand-drawn line diagrams were used frequently during this research[154] because these allowed the researcher to highlight key aspects important to perception of scale effect whilst avoiding the distraction of superfluous information that usually exists in photographs[155]. Nonetheless, as a visual image, these drawings still focus attention upon visual aspects of the landscape, for example the visual scale of an element rather than spatial scale. Thus they, like other visualisations, should only be used as one tool for communication and it is important to not over rely on images compared to descriptive words which will be the only format in which some scale effects can be conveyed when not on site.

It is important through communication to understand what is most important with regards to scale and scale effects; yet this research found that the issues raised by people during consultation may be influenced by their perception (consciously or not) of the scope for attributes to be altered. Thus it is important when prompting or facilitating communication to highlight that it is desirable to know people's 'true' perceptions: partly so that the 'true' effects of a scheme can be understood (whether these can be mitigated or not); and partly to encourage exploration of all types of mitigation (including methods of which the participant might not be aware) as necessary.

## 8.3 Confirmation of the hypotheses

Following address of the research questions, this section reviews whether the research findings confirm or disprove the hypotheses which were identified at an early stage of the research and represent key issues raised in practice (described in 2.10).

[154] Following supportive feedback received during consultation and pilot studies.
[155] These line drawings also limit variation between the presentation of images if viewed on different computers

### 8.3.1 *Hypothesis a: Different wind turbine sizes and numbers result in different scale effects within different landscape types, with thresholds occurring between these*

The findings of the research confirm this hypothesis with regards to wind turbine size and numbers. Nonetheless, the research has shown that the relationships between wind turbine size and scale effect and wind turbine numbers and scale effects are not constant. Furthermore, it was found through the ACBC study that there was no correlation between the relative importances for scale effect of the attributes of wind turbine size and wind turbine numbers.

This hypothesis is also confirmed with regards to the influence of landscape type on scale effects, although not as strongly as might have been expected given the emphasis on landscape character within sensitivity and capacity studies. In contrast, it was found that the experience of the landscape had greater importance for perceived scale effect than landscape type. It is important to highlight that this does not mean that landscape type is not important *per se* with regards to the sensitivity of an area to windfarm scale effects but, instead, that differences of landscape type are less influential than some other attributes on people's perception of an overbearing scale effect.

Although sensitivity to scale effects (and other landscape and visual effects) within LVIA and sensitivity or capacity assessments is often assessed in relation to individual landscape types, the findings of this research revealed that more influential on the perception of scale effects was how a windfarm related to the range and combination of different landscape character types within an area and how these were experienced. Additionally, it was found that scale effects were judged to be greater where the scale of a windfarm meant it extended over multiple landscape types.

Through the research, there was clear support for the hypothesis that there are distinct thresholds of scale effect related to the scale of windfarms and different landscape types. This was a finding of the LVIA and experiential landscape assessment methods through both assessment of different windfarms within different landscape types (section 5.3) and through reference to computer-generated wireline diagrams that showed wind turbines at different heights (Appendix D.12). Importantly, during this research, it was found that changing windfarm scale sometimes resulted in no significant change in scale effect, as a development remained within the same category of scale effect but that, conversely, a further smaller change could sometimes make a significant difference. The presence of thresholds of effect was also supported by the findings of the ACBC study for which it was found that part-worth utility scores were not equal between the levels of different attributes.

### *8.3.2 Hypothesis b: People's perception of scale effect relates closely to their experience of a landscape*

This hypothesis is confirmed by the findings of this research, particularly through the experiential landscape assessment that included semi-structured interviews with local people (both professionals and the public) within three case study areas. Through this research, people described a close relationship between their perception of scale effect and their experience of a landscape.

The ACBC study revealed that private/ personal locations were the type of landscape context of experience that were judged as having greatest sensitivity to a perceived overbearing scale effect in contrast to public locations. Although this had been expected for individuals, less anticipated were the findings that suggested that people were concerned about these effects collectively, influencing the wider landscape and community. In contrast, it was revealed that a perceived overbearing scale effect was less likely when carrying out activities that were temporal and mobile, such as driving. Another surprise finding with regards to the experience of the landscape and scale effects was the relative importance of experiencing spatial separation and this was more important than other factors such as the presence of scale cues. This contributed to open landscapes such as moorland being judged as having higher relative importance to scale effects than more enclosed landscapes.

### *8.3.3 Hypothesis c: People's perception of the scale effect of windfarms relates to the proximity of a windfarm, the scale of a windfarm, the character of the landscape and people's attitudes to windfarms*

This hypothesis is confirmed in parts, but not others. Through the research, the influence of proximity on people's perception of scale effect was found to be very strong, and much greater than predicted from either the theoretical background or the review of planning responses and representations. Indeed, the ACBC study found that proximity was the attribute of highest relative importance to people's perception of an overbearing scale effect and higher than either wind turbine size or windfarm size.

As described for hypothesis 'a', it was found that perception of scale effect was influenced by landscape type. Nonetheless, this was found to be more complicated than commonly identified in LVIA and capacity studies that tend to relate sensitivity of scale mainly to landform scale, landscape pattern and openness. Whilst these factors are influential, it was found through this research that there are many others.

People's perception of scale effect was found to relate to their attitudes to both the local landscape and windfarms in general, and thus confirms the hypothesis in this respect. Nonetheless, in support of recent published literature, there was no indication that these responses were strongly influenced by self-interest but, instead, were most strongly influenced by people's perception of the specific characteristics and qualities of the landscape, how these were experienced and valued, and how a windfarm would affect communities of interest and place.

Through the ACBC study, it was found that there was a remarkable consistency of responses across all the demographic groups with regards to judgements of scale effect. Nevertheless, in support of the hypothesis, there were some differences between those with positive and negative attitudes to wind energy development on the rankings of the average importances for the three windfarm attributes and the part-worth utilities for some of the landscape types.

### *8.3.4 Hypothesis d: Wind turbines that appear 'out of scale' within the landscape will typically have significant adverse landscape and visual effects*

The findings of this research suggest support for this hypothesis as a strong link was found between judgements of windfarms being 'out of scale' and judgements of the significance of adverse landscape and visual effects. Indeed, for some cases, a judgement of being 'out of scale' by a decision-maker was the main reason given for a scheme to be judged as unacceptable in terms of its landscape and visual effects. Nonetheless, it is not possible to say that this hypothesis is definitely proven or not because of the ambiguity that was found during this research regarding use of the term 'out of scale'. Published literature and review of planning responses and planning policies indicated that the term 'out of scale' seemed to relate mainly to perceived compatibility with baseline characteristics and other features of a landscape but, where used as a test in planning, it was typically undefined.

A further factor casting doubt on the proof for this hypothesis is the potential for a windfarm to appear 'out of scale' and to have significant landscape and visual effects, but for these to be judged as beneficial rather than adverse. This could be because it is perceived as having positive symbolic qualities. GLVIA3 raises the possibility of this effect, referring to testing of whether effects are beneficial or adverse partly on the basis of '... *the contribution to the landscape that the development may make in its own right, usually by virtue of good design, even if it is in contrast to existing character'* (p88). Nonetheless, this kind of positive 'out of scale' relationship tends to be the exception, rather than the norm, and it would need to be judged as 'out of scale' and positive by the people that would experience it as part of their everyday landscape as well as those that see it as an occasional attraction.

### *8.3.5 Hypothesis e: Perception of scale effects change over time in relation to the range of scales of structures that occur within a landscape and that have been experienced by people*

The findings of this research confirm this hypothesis in its broadest sense, as it was found that scale effects do change over time (as do other landscape and visual effects), partly because scale is a relative judgement and thus the references used to judge it may change. Nonetheless, the hypothesis does not reflect that there are three different ways in which we use scale references (as shown in Figure 8.1): in relation to a total range or measure; in relation to other elements (including ourselves as humans); and in relation to what we think is normal. This means that, although some scale references may change over time, some will usually remain the same, and thus changes to overall scale effect does not necessarily follow.

Regarding familiarity with windfarms, this research found no evidence to indicate that perceived scale effects reduced over time through increased familiarity. Conversely, through the experiential landscape assessment for case study A, where there had been an existing windfarm for five years, participants highlighted how the landscape and visual effects of the windfarm had persisted, partly because of the windfarm's ever-changing appearance reflecting different weather and light conditions.

### *8.3.6 Hypothesis f: Typical applications of standard LVIA methods (as part of EIA) do not adequately convey the scale effects of a proposed windfarm*

The findings of this research support this hypothesis, particularly through the review of existing LVIA reports in comparison with the sensitivities to scale effects identified through site assessment for the LVIA method and through semi-structured interviews for the experiential landscape assessment. The LVIA reports analysed by this research followed the second edition of GLVIA and, through review of GLVIA3 (2013), it was found that this describes more clearly the scope to assess and convey the scale effects of a proposed windfarm (described in 8.2). Nonetheless, it is judged that further guidance, clarification or prompts will be required in addition to those provided by GLVIA3 for most practitioners to assess scale effects satisfactorily. In addition, greater emphasis needs to be placed on the importance of spatial scale and people's experience of the landscape (whether this is a part of the LVIA or within a separate experiential landscape assessment), with the latter being informed by participatory consultation with professionals and the public.

This research identified that one of the problems of conveying clearly the scale effects of a proposed windfarm through LVIA, as well as through other assessments, is the use of different words to describe scale and scale effects. Thus, to convey clearly the scale effects of a proposed development, LVIAs must use clear and defined terms when describing both qualitative and quantitative aspects of scale, and also describe the type of scale assessed and the types of scale reference made.

## 8.4 Limitations of the study and opportunities for further research and development

This section describes the limitations of the research as well as opportunities for further research and development of the findings. Some of the limitations identified reflect that a balance had to be struck between setting the scope of the research too wide, so that the resultant findings were very general and had limited application, or setting the scope too narrow so that the resultant findings were too specific and had limited application. Nonetheless, on reflection, some of the limitations highlight that the research could have been carried out in slightly different ways that may have led to alternative data or findings. These limitations also indicate potential opportunities for additional research and development in the future.

The key limitations of the research are listed below.

a The research was limited to three case study areas. The inclusion of additional case study areas would have allowed assessment of the sensitivities of scale effects within additional landscape and seascape character types.

b The sampling for the questionnaires was not fully randomised and the demographic characteristics of respondents were not representative of the general Scottish population.

c The range of windfarm characteristics considered by the research was limited by those operational or proposed within Scotland during the period of the research. This limited the number of wind turbines assessed within a windfarm to <215 and the tallest wind turbine assessed to <196m. In addition, the research did not study in detail the influence on scale effects of windfarms of different colour, noise, layout or blade rotation, although these factors were considered as part of the study context.

d Review of LVIAs for existing windfarms was limited to seven in number. Review of additional LVIAs may have revealed alternative ways in which sensitivities to scale and scale effects had been assessed for other proposals. Furthermore, there was no LVIA available for review for case study C.

e The research had to consider two different editions of GLVIA as the guidelines were updated part-way through the research. This meant that the existing LVIA reports reviewed had followed a different edition (2nd) than will be used in the future.

f There were fewer participants for the experiential landscape assessment for case study C (an area of neither an existing or proposed windfarm) as it was more difficult to encourage the public to be involved with this case study than either A or B.

g The data from the semi-structured interviews and site assessment for the experiential landscape assessment were analysed, classified and described together. This meant the data derived from the separate processes were not distinguished within the description of the overall findings.

h The questions regarding people's attitudes and occupations within the public attitude and preference study questionnaires were not structured in a way that was most conducive to subsequent data analyses.

i Some participants found the Likert scale unclear for the public attitude and preference questionnaire examining the words people use to describe scale effects and thus use of the data had to be modified.

j The BYO and screening exercise for the ACBC method did not generate a great deal of relevant data, partly because of the number and type of attributes used.

k The wording for some of the ACBC questionnaire questions was awkward because of the unconventional use of the questionnaire to identify a negative effect, for example including double-negatives for the 'unacceptables'. This was unavoidable following the standard software set-up.

l The research did not consider in detail the influence of cumulative scale effects where numerous windfarms occur in an area.

m It was not possible to test application in practice of some of the research findings, for example the use of the provisional prompt lists and notes.

Further information on these limitations is provided within Table H.2.1 of Appendix H.2.

Building upon the findings of this research and the limitations summarised above, a number of potential opportunities for future research and development have been identified. These include expansion of the scope of the research already completed, as well as further development of some of the methods that have been applied. They are summarised in Table 8.2 overleaf.

| Table 8.2: Potential opportunities for additional research and development that builds upon the research findings | | |
|---|---|---|
| *Main subject* | *Aspect* | *Description of research opportunity* |
| Windfarm characteristics | Wind turbine form | Research the perceived scale effects of wind turbines of different form, including different proportions of wind turbine blades to towers. |
| | Wind turbine size | Research in detail the scale effects of windfarms that are 150m to tip or larger, including the potential scale effects of these being lit. |
| | | Explore the effects demonstrated by additional examples of windfarm repowering and extensions and explore the changes in perceived 'normal' benchmarks for wind turbine and windfarm scale. |
| Windfarm siting and design | Prompt list/ guidance | Explore further the content and use of a prompt list and/or guidance for the siting and design of windfarms to minimise adverse scale effects (described in 8.2) |
| Windfarm sensitivity and capacity studies | Categories of windfarm type | Explore the process by which sensitivity and capacity assessments consider attributes influencing scale effects and categories of windfarm type in relation to thresholds for scale effects. |
| Expansion of existing research | Perception of scale for offshore windfarms | Assess the perception of scale effects of windfarms offshore, including cumulative effects experienced from nearby coasts. |
| | Additional landscape types with attributes relevant to the perception of scale effects | Consider expansion of completed research within other landscape types, for example different seascapes, mountain areas and urban areas. |
| | Additional contexts of landscape experience | Consider expansion of completed research for additional landscape experiences, for example within different settlement contexts, using different modes of travel or whilst carrying out different activities. |
| | Identify relative importances of other attributes influencing scale effect | The ACBC method developed for this research could be developed further to identify the relative importances of other attributes affecting the scale effects of windfarms, for example some of those described within Table D.8.1 of Appendix D.8 but not included in the ACBC study for this research. |
| | Scale effects of cumulative schemes | Assess influence of numerous windfarm schemes on perception of scale effects, including perception of scale references based on what is considered 'normal' and comparison between windfarms. |
| LVIA | GLVIA3 | Review whether LVIAs produced following GLVIA3 assess scale effects and landscape experience different to those reviewed by this research following GLVIA2. |
| | | Explore further the content and use of a prompt list to assist people to follow GLVIA3 to assess scale effects and the landscape experience. |
| | | Explore how the terminology in GLVIA concerning scale |

| Table 8.2: Potential opportunities for additional research and development that builds upon the research findings | | |
|---|---|---|
| *Main subject* | *Aspect* | *Description of research opportunity* |
| | | could be clarified further. |
| | | Consider how scale effects and the experience of the landscape can fit best within the division between LIA and VIA within the structure of LVIA following GLVIA. |
| LVIA/ Experiential landscape assessment | Public participation | Explore further how to engage local people within LVIA and/or experiential landscape assessment so that they will highlight sensitivities of the landscape (including scale and the experience of the landscape) as well as providing information for other interests. Explore how this can be facilitated in different ways, who should be involved and how it could be integrated within the planning system. |
| | | Explore and test the use of a prompt list, guidance or toolkit for planning LVIA or experiential landscape assessment participatory consultation (provisional prompt list included in Appendix H.6) |
| | | Explore the use of sample routes for participants to take through the landscape to assess and record their experience of the landscape and perception of scale, including the potential to take computer-generated visualisations on paper or use Augmented Reality (AR) on a computer tablet. |
| Communication | Glossary | Explore development of a glossary to define terms used to describe different aspects of scale in the landscape, perhaps as an extension to an existing established glossary. |
| Public attitude and preference study | Representation of participants | Consider further distribution of a questionnaire to examine the words people use to describe scale effects so that the respondents represent the general Scottish population. |
| | | Consider further distribution of the ACBC questionnaire to gain better representation of demographic groups, such as those of younger age. |
| | | Develop categories for people's attitudes to windfarms and knowledge of relevant information for use within public attitude and preference studies that would facilitate better data analyses for understanding perception of scale effects in the landscape. |
| | Likert scale for words to describe scale effect | For the questionnaire to examine the words people use to describe scale effects, re-run including words already identified as most discriminating but with revised Likert scale. |
| ACBC | Acceptability of scale effects | Building upon the ACBC questionnaire for this research (that revealed the relative importances of different attributes to create an overbearing scale effect), it would be useful to develop another ACBC questionnaire to examine where the thresholds lie for different scale effects and for compatibility at different levels, for example when a windfarm is judged as being 'in scale' or 'out of scale'. |
| | Research of perception of other | The ACBC method developed for this research could be developed further to be used to identify the relative |

| Table 8.2: Potential opportunities for additional research and development that builds upon the research findings | | |
|---|---|---|
| *Main subject* | *Aspect* | *Description of research opportunity* |
| | landscape qualities or effects | importances of other landscape and visual attributes to create other landscape or visual effects or qualities. |
| | ACBC wording | When using ACBC to identify relative importances for different attributes influencing negative landscape and visual effects, consider how it is possible to provide clearer wording for the 'must haves' and 'unacceptables' within the screening exercise. |

## 8.5 Application of the research findings through practice and policy

This section describes how the findings of this research could be applied in practice and policy. Given the nature of this research, it is expected that the findings will be used most directly in landscape architecture practice and planning policy concerning windfarms within Scotland. Nonetheless, the research findings may also inform practice and policy in related disciplines, for other development types and in other geographical areas. Furthermore, it may inform the use of the same or similar research methods for alternative topics in landscape architecture or related disciplines.

Throughout this research, the relevance and use of the research findings in policy and practice have been considered. To help achieve this application, links have been made between the methods used for this research and those used in conventional practice and by carrying out consultation with practitioners and stakeholders.

The main ways in which the findings of this research can be used in policy and practice are listed below and shown in Figure 8.3 overleaf:

- Informing which aspects of scale need to be assessed;
- Informing methods to assess a landscape, people's experience of this and scale effects;
- Informing how to communicate scale effects for clearest understanding;
- Identifying siting and design approaches to minimise adverse scale effects; and
- Informing the setting of thresholds of scale effect and acceptability.

The findings of this research are likely to be increasingly important to future policy and landscape architecture practice given the trend for use of larger windfarms and other structures for energy generation and transmission (described within the background to this research in chapter 1). This will include 'repowering' of existing windfarms, where existing wind turbines are replaced by larger machines upon the same site.

The planning policy within Scotland for which scale effects is most relevant is set by Scottish Government (2014a) and is supported by guidance from other organisations such as SNH in Scotland, the Landscape Institute covering the UK, and council planning authorities at a regional level.

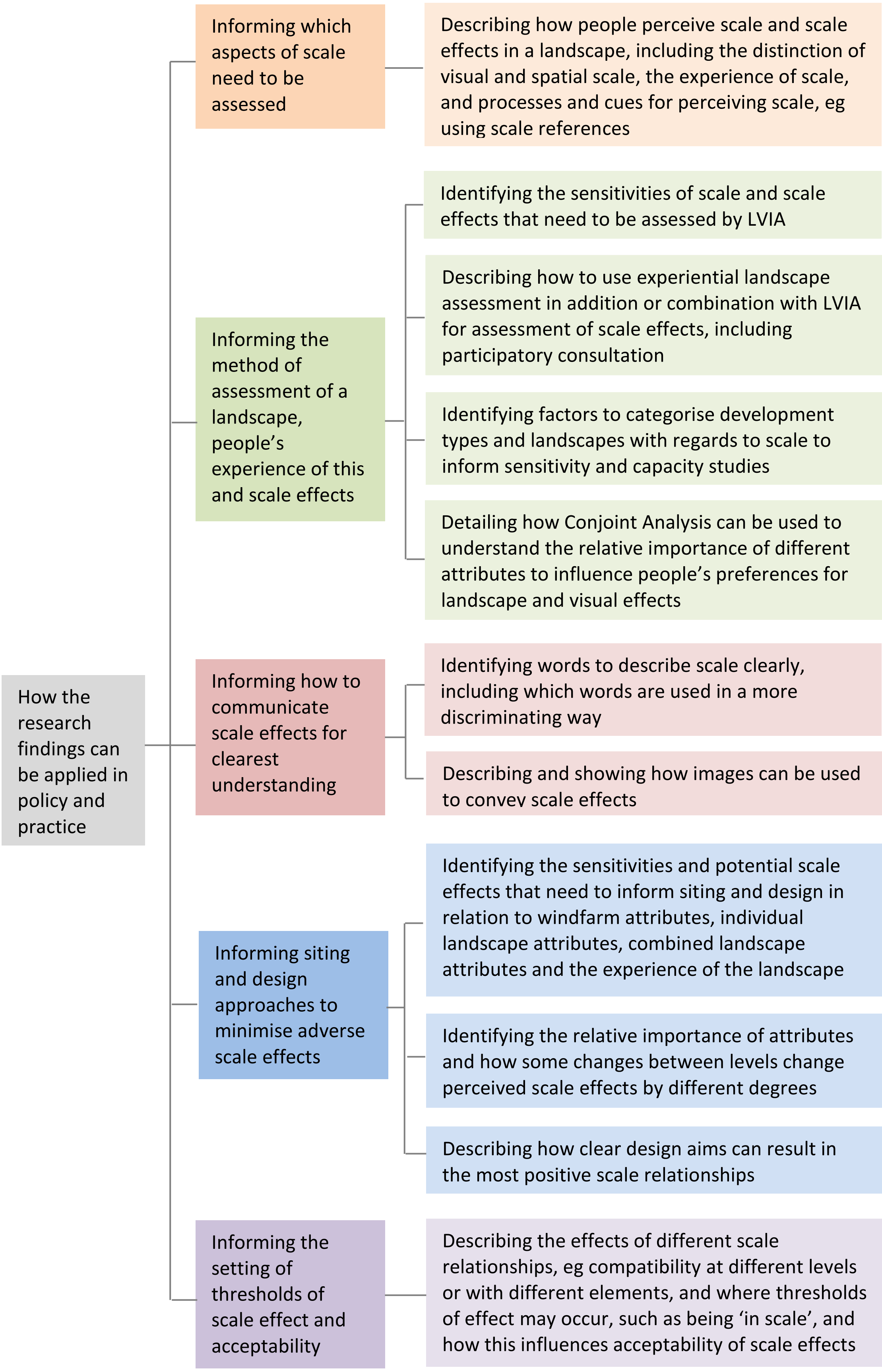



Figure 8.3: Application of the research findings in policy and practice

Whilst considering potential application of the research findings in policy and practice, six issues were identified as being particularly important to emphasise given existing shortcomings in practice and policy with regards to the consideration of scale effects. These are the need for: good communication; participatory consultation with local people; assessing how a landscape is experienced; identifying what is important; considering collective sensitivity of effects; and using the findings of assessment of scale to inform siting and design. Additional notes on these aspects are included within Table H.4.1 of Appendix H.4.

### *8.5.3 Application of the findings for large structures other than windfarms*

When considering the potential scope for applying the findings of this research, one issue is whether the findings can be applied to large scale structures other than wind turbines. The theoretical background to this research (reported in chapter 2) mainly regards perception of scale in general and makes reference to literature that concerns a wide range of structures, and thus this information would be relevant to large structures other than windfarms. The only section of the theoretical background that is development-specific is section 2.7 on public attitudes to windfarms.

As mentioned in chapter 1, the primary reason for selecting wind turbines as a development type to research scale effects was that these were consistent in form and lacked the scale references that other structures possess, such as windows on different storeys. This does not mean that the findings of this research cannot be applied to other large scale structures, but it does mean that perception of the scale of these other structures may be influenced by the indicators whose omission meant wind turbines were chosen, for example antenna or dishes upon telecommunication masts.

The findings of the LVIA and experiential landscape assessment for this research, including identification of characteristics of the landscape and the experience of these sensitive to the scale of windfarms would be relevant to other large scale structures. In addition, when assessing the scale effects of these, it may be useful to adopt some of the same methods used in this research, including participatory consultation and Conjoint Analysis. Furthermore, some of the lessons learnt concerning communication could also be applied, for example selection of words that are used in the most discriminating way to describe different scales and scale effects.

## 8.6 Contribution to knowledge and understanding

This research generated a large number of findings, as described throughout this thesis report. At the end of each of chapters 5, 6 and 7 as well as this chapter 8, summary diagrams highlight key findings that were new, unexpected or that challenge our current understanding (Figures 5.29, 6.9, 7.35 as well as Tables 8.3 and 8.4). Reflecting upon this information and the preceding sections of this chapter on potential applications of the findings, the following section highlights some of the main ways in which this research advances knowledge and understanding in its field.

### *8.6.1 Improving understanding of the complexities of scale perception in the landscape and providing a link between theory and practice*

This research outlines the complexity of scale perception by drawing upon theory and applying this to the experience of scale in reality in a landscape. There are many influences and thus, to improve understanding, the research findings are structured by the different ways in which we *perceive* scale and scale effects, the different *sensitivities* to scale effect in a landscape, and the different ways in which we *experience* scale effects in a landscape.

To improve understanding of scale perception, the research applied a number of different methods to the problem statement and research questions, so that it considered scale perception in different ways and made the link between standard methods used in landscape architecture practice, less conventional methods exploring landscape experience that include consultation, and methods used more commonly in other professions, such as ACBC in marketing. In addition, it considered both separate influences on scale perception and individual attributes of a landscape and windfarm type sensitive to scale effects, but also how these combined and were experienced within the case study areas. Finally, to convey as clearly as possible the complexity of scale perception, the research presents information in various formats, for example flow diagrams, tables that make a link between baseline qualities and effects, and by using many explanatory line drawings.

### *8.6.2 Supporting the importance identified for communicating scale effects clearly and highlighting the ambiguity of some current terms used to describe scale*

The findings of this research support other studies by highlighting that good communication is vital to convey the characteristics and qualities of a landscape and the specific effects of a scheme. Furthermore, through comparison of information provided in different ways, including review of responses and representations to planning applications, LVIA reports and how people described scale effects during consultation, it was found that some words describing scale and scale effects were being used ambiguously and/or interchangeably, for example 'large-scale', 'dominating' or 'out of scale'. The research explored this further to understand which words people use to describe different scale effects in the most discriminating way and also what people actually mean when using certain terms such as 'in scale' or 'out of scale'. Through this process, this research highlighted how this ambiguity may mean that aspects of scale perception and effects are omitted from assessments because the assessor believes mistakenly that they have considered 'scale' sufficiently when, instead, they have only assessed this partially, for example just assessing 'scale' in terms of magnitude of effects, or only visual scale effects.

### *8.6.3 Identifying the relative scope of different assessment methods to assess scale effects and what is important to assess*

The findings of this research identify the attributes that may influence perception of scale and scale effects in a landscape and thus need to be assessed for a development proposal. The research explored and reveals how different assessment methods can provide this information.

For one of the methods, LVIA, the research findings identify what the standard method offers and also how it is typically applied in practice to assess scale effects. This allows identification of how it could be expanded, modified or supplemented in the future to address scale effects and the landscape experience of these. Importantly, the research findings also highlight what LVIA does not offer or is weak in offering due to its specific emphasis and what information may be better provided using other methods.

In comparison to LVIA, the findings of this research reveal what can be achieved through the method of experiential landscape assessment, focused upon the relationship between landscape and people, rather than on a proposed development. In addition, this research revealed how public attitude and preference studies can provide additional information on the relative importances of different attributes affecting scale effect, providing greater understanding of people's priorities when judging the relative influence of these attributes (even if they are not aware of this preference).

The findings of this research support the findings of other studies regarding the value of participatory consultation (both with professionals and the public). Specifically, they identify the extra value that can be gained in addition to common LVIA and EIA practice, highlighting the two-way benefits: professional assessors learning from local people about the sensitivities of the landscape to scale effects and how people experience the landscape; and, in reverse, local people gaining better clarity through the assessment process about what they value in their landscape and why. Through this research, it was also highlighted that this information is often not obtained through other processes assumed to be sufficient, such as EIA scoping consultations. This may be partly because people are not able to comprehend or articulate the key sensitivities of a landscape to a proposed development and also their experience and value of these.

The research applied both conventional methods of assessment, such as LVIA, and some more unusual or innovative methods, such as experiential landscape assessment and ACBC. The latter two required further development and modification so that they addressed the research questions. Nonetheless, by doing so, this research revealed new ways in which these methods can be used and applied in the future, for example using experiential landscape assessment over a more extensive study area than usual and applying ACBC analysis to identify the relative importances of attributes to create a landscape effect (rather than the more conventional use to identify product preference). Review of the findings of this research has also allowed identification of how these methods may be developed further, both to expand the findings of this research and to address other issues.

The importance of the perception of effects by people is highlighted through the range of assessment methods used for this research. This demonstration of how perceived effects should and can be taken into account, building upon the theoretical background, is important because the complexity of perception can lead some practitioners to dismiss this as too difficult to incorporate. In addition, when people are aware of the influence of perception, but not sure how to take it into account, they often limit their assessment to what they do know, for example focusing on linear perspective from a specific viewpoint, rather than also including other important aspects such as assessing changes of perceived effects when moving through a landscape.

### *8.6.4 Revealing and confirming the relative importance of attributes*

In addition to identifying which attributes influence scale effect and the experience of these, the findings of the ACBC study for this research identified the relative importances of these to influence scale effect. This information is particularly valuable because it is difficult to obtain through other methods: partly because perception of scale is context dependent; and partly because people often do not know their priorities in terms of the preferences that lie behind their judgements. Another reason this information is important is that, during the siting and design process of any structure, various options need to be considered which all have implications in terms of different landscape and visual effects; thus it is very useful to be able to know the relative importances of various changes on the likely scale effects of a scheme.

An encouraging finding of this research was that, through carrying out experiential landscape assessment and the ACBC questionnaire, a number of participants said that they understood better how they experienced scale and their preferences. For some people, this led them to reject some long-held assumptions regarding perceived scale effects through being forced to make choices. For example, one respondent reported that they had expected to rate public viewpoints as most sensitive to scale effects, but found that, through making trade-offs, they actually believed private spaces to be more important. In addition, the research revealed that proximity of a windfarm was the attribute that was judged on average as most important to perceived scale effect, in contrast to planning responses and representations which typically raise wind turbine size and/or numbers as being of greater concern.

## 8.7 Final conclusions

This research began with identifying a problem: that although scale is very important to us and how we experience our surroundings, people find it difficult to predict and convey the scale effects of large structures proposed in a landscape. The research investigated why this problem occurred, taking wind turbines as a development type. It was found that key factors were the disparity of scale between large wind turbines and other elements in a landscape with which scale reference could be made as well as a difficulty of demonstrating to people the scale effects of a proposed development. Within the discipline of landscape architecture, this problem needed to be addressed for two main reasons: one so that landscape architects can advise people about the scale effects of a proposed development in a landscape; and, two, so they can site and design structures that are of appropriate scale and contribute positively to the landscape.

To explore and consider the research problem, reference was made to a broad range of literature that formed the theoretical background. Within this range, it was revealed that there was a great deal of material on vision, visual perception and aesthetic proportions and thus this research could build upon the solid foundation this provided. Nonetheless, gaps were identified in the theoretical background, particularly regarding the combined effects of different perceptions and how people perceive the scale of large structures in various landscape contexts.

Reflecting the research problem and theoretical background, a number of research questions were identified as follows:

- How do people perceive the scale effects of windfarms in a landscape?
    - How do different scales of windfarm in different landscapes create different scale effects?
    - How can we site and design windfarms to minimise adverse scale effects?
    - How can we best assess the scale effects of windfarms in the landscape?
    - How can we best communicate scale effects to different people?

The research addressed these questions using three different methods. The first of these, LVIA, was found to be very useful for its structured approach and for offering a link between conventional assessment of scale in the past, by this research, and for the future.

Nonetheless, it was found lacking in clarity when following GLVIA in its different references to scale, the incorporation of information on sensitivities to scale effects from public consultation, and including assessment of visual scale, spatial scale and the experience of scale in the landscape (although these aspects are not excluded from the process of LVIA *per se*).

In contrast to LVIA, for which the focus is a proposed development, the second method of experiential landscape assessment focuses upon people's relationship with a landscape and affordances. This approach was revealed to be much easier for people to engage in through consultation and facilitated the identification of how characteristics were experienced in combination - visually, spatially and experientially – and how and for what they were valued. Nonetheless, a challenge of the consultation for experiential landscape assessment was the time and resources required for all those involved, which was particularly demanding over large study areas. In addition, the inherent flexibility of the process demanded a large amount of data processing to categorise findings.

Finally, the third method of public attitude and preference study helped bridge some of the weaknesses of the other two methods. One questionnaire was undertaken to find out what words people use to describe scale effects and a second questionnaire, an Adaptive Choice-Based Conjoint (ACBC) analysis, built upon all the findings of the previous research methods regarding the attributes that influence scale perception to reveal the relative importances of some of those that were most important or unclear. This was extremely useful as, through the consultation with both professionals and members of the public during earlier stages, there had been a tendency for people to say that all the attributes were important and/ or 'it all depends…', but the ACBC forced people to make trade-offs and choices and, through these, reveal their priorities in terms of preferences when judging scale effect. This information is very valuable because it helps an assessor understand how people will judge the scale effects of different windfarm scenarios, as well as helping a designer understand the relative benefits and disadvantages of different options for siting and designing a windfarm to minimise perceived overbearing scale effect.

Throughout the research, a key issue raised repeatedly was the need for clear communication regarding scale effects. This was first explored when considering the problem statement, as frequent comments were received from consultees that there was an inconsistent relationship between the dimensions of wind turbines quoted in planning applications and the perceived scale effects of windfarms. No published literature was found to support this hypothesis, so an exploratory survey was carried out as part of the background research to consider this problem further. This revealed that the consultees' suggestion was well-founded: that most people could not link the dimensions of a wind turbine's height and distance with the resultant scale effects observed on site[156]. This highlighted that it was unhelpful for reports to rely on describing developments using units of measure as the basis for people to make judgements of scale effect.

An alternative to using numbers to convey scale effects is the use of images or words. With regards to the first of these, the findings of this research supported background literature: that photographs and computer-generated visualisations are not able to convey well scale effects in a landscape unless these can be compared directly to an actual view on site which allows application of the relevant processes and cues for perception. In addition, not surprisingly, the use of images to represent scale and scale effects was found to be significantly limited by the fact they can only represent sample points and not the dynamic and sequential experience of a landscape. Alternatively, with regards to the use of words to describe scale effects, a problem was found early on during the research, which was that there was inconsistent use of words to describe scale effect, for example with some people using the same words to describe different scale effects and some people using different words to describe the same scale effects. As the research progressed, the importance of this issue was emphasised repeatedly as it provided an obstacle to people understanding descriptions of scale (both professionals and the public). It also had implications for planning, as it was found that some of the tests for acceptability, such as being 'in scale', were understood by different people to mean different things. Further research regarding this issue of consistency revealed it was rooted partly in an assumption that we often think mistakenly that we know what others mean when they describe scale (Adler, 2012). As mentioned previously, a questionnaire was developed subsequently to address this ambiguity and find out which words were used by people to describe different scale effects

[156] For example, only 22.5% of participants estimated the size of a wind turbine within +/- 20% of its actual size. Further details are provided in chapter 1.

and this found that the word ‘overbearing’ was used in the most discriminating way to describe a high scale effect.

Related to the issue of communication and how scale is described, and building upon the theoretical background, the research findings highlighted important differences between different types of scale that need to be distinguished for clarity, as described in 8.2. This includes the distinction between visual scale and spatial scale, as well as the different ways in which people make scale reference.

The research findings from the LVIA method revealed that many different landscape and windfarm attributes influence our perception of scale in the landscape. This was not unexpected, given the background research, but it was nonetheless useful to identify these separate attributes so they can be considered within the contexts of different landscapes and windfarm proposals. In reference to all the sensitivities to scale effects raised by the research, review of existing LVIA reports for proposed windfarms found that these rarely described scale effects in any detail and, if mentioned, mainly referred to just the visual scale effects and neither spatial scale nor how scale effects would be experienced by people. Review of GLVIA[157] found that this offered scope for including within future LVIAs consideration of the full range of scale effects identified by this research. Nonetheless, to achieve this, most users would benefit from further clarification or guidance, for example because reference to scale within GLVIA is ambiguous in places which may lead some assessors to think incorrectly they have considered relevant issues sufficiently.

Building upon the research findings of the LVIA method, the experiential landscape assessment revealed how individual attributes of the landscape are experienced in combination and valued by people. These findings supported the background research by revealing that people’s perception of a landscape reflected a composite of different experiences, established whilst carrying out different activities at different times for different purposes. This combination of experiences was particularly important to scale perception as, being a relative quality, the scale of one place or feature was judged in relation to another. The complexity of these experiences of scale and what was important

[157] The existing LVIAs had been produced following the second edition of GLVIA, but the third edition of GLVIA was also reviewed to consider scope for application of these guidelines in the future.

to people were revealed during consultation with both professionals and the public within the case study areas for this research. Through this process, it was found that the experience of the 'everyday' landscape was particularly important, including journeys, vantage points, reference points, and hills and horizons, influencing people's sense of their place within the landscape. It was also found that people's perception of scale effects were influenced by perceived collective effects upon an area or community, not just effects on them individually and/or from isolated locations, and that the spatial scale was as important as the visual scale of a landscape. Finally, local people described their experience of living with the scale effects of a windfarm, describing how these effects persisted over time due to a windfarm continuing to look different in ever-changing weather and light conditions.

Building upon the findings of both the LVIA and experiential landscape assessment methods, the findings of the ACBC questionnaire revealed the relative importances of landscape and windfarm attributes on people's judgement of scale effect. Some of these findings supported those of the other methods and the background theory, whilst others revealed some new and more unexpected results. From the range of attributes included within the ACBC, the findings revealed that the proximity of a windfarm had greatest relative importance on people's perception of scale effect, followed by windfarm size, wind turbine size, context of experience, and landscape type. Importantly, this ranking was quite different to the priority of issues raised through planning responses and representations for which wind turbine size was typically raised as being of greatest concern. Following further consultation, it was found that the difference between importances revealed through the ACBC and those conveyed in planning responses may exist because people tend to highlight aspects they think can be changed relatively easily, such as wind turbine height but, in doing so, they may not have highlighted what they believed to be most important to the scale effects of a scheme.

Countering a common assumption that setting the scale of a windfarm involves a choice between fewer large wind turbines or a greater number of small wind turbines[158], this research revealed there was no correlation between people's perceived importance for wind turbine numbers and size in terms of scale effects and that people judged horizontal

[158] ie, believing mistakenly that these choices would have the same total effect

scale differently to vertical scale. In addition, through comparison between the relative importances for the different windfarm attribute levels, it was found that there were unequal differences in the part-worth utility scores between the levels, indicating perceived scale effect is not directly proportional to changes in distance, wind turbine size or windfarm size, and that key thresholds occur between different effects.

With regards to the context of experience and landscape type attributes, a key finding of the ACBC study was the influence of spatial separation. This supported some of the findings of the LVIA and experiential landscape assessment, but also contradicts a common assumption in landscape architecture practice that open landscapes such as moorland are typically not sensitive to scale effects. Conversely, whilst the *visual scale* of a windfarm may not appear overbearing in relation to the expanse of an open landscape, a windfarm may be overbearing upon the *spatial scale* characteristics if there is no obvious separation between a viewer and a development and a lack of distance cues to reassure the viewer that it is far away.

Other findings of the ACBC research that supported the other methods included the high sensitivity of locations where people tend to stay in one place, such as residences, from where effects are not temporal. In addition, although this research did not explore in detail the influence of wind turbine form on perception of scale, a notable finding was that a high proportion of participants (80.5%) judged that wind turbines with longer blades in relation to tower height appeared more overbearing in scale effect. This is a particularly important finding for windfarm development in Scotland where there is a trend to use wind turbines with increasingly long blades in relation to their tower heights.

On reflection, combining the three methods for this research proved very valuable, not just for their different approaches and provision of triangulation, but also for revealing the range of information on scale effects and the experience of a landscape which can be obtained through methods of research and professional assessment. This contrasts with the limited range of information typically provided for planning applications from which people struggle to understand the potential scale effects of a windfarm.

The research revealed the scope of LVIA if following GLVIA to assess scale effects, as well as the high value of participatory consultation (either as part of LVIA or experiential landscape assessment) with local professionals and members of the public in combination with site assessment. In addition, the research revealed how public attitude and preferences studies, for example as offered by Conjoint Analysis, can assist understanding of the relative importance of many different landscape and development type attributes, addressing the common response that 'they are all important' or 'it all depends…'. Through understanding the scope of these methods, it was also possible to understand better what cannot be provided, to avoid unrealistic expectations, for example what cannot be achieved through relying upon desk-based study and omitting site assessment, consultation and clear definition of scale effects.

For the siting and design of a specific windfarm in the future, the research findings cannot provide a simple answer to the question of what scale this should be, as scale effects vary in different contexts and suitability depends on the nature of scale relationship desired. Nonetheless, this thesis describes what aspects of scale perception and scale effect need to be considered for a proposal and how the answer can be obtained through different design and assessment processes.

Tables 8.3 and 8.4 overleaf[159] summarise the main research findings that are new, unexpected or that challenge current understanding.

Building upon existing theory and addressing the research questions raised by this research, this thesis contributes to knowledge and understanding in its field by explaining how people perceive the scale and scale effects of windfarms in a landscape. By applying this knowledge, it is hoped that structures developed in the future can be of scales that have positive effects on the landscape and upon the people that experience them.

[159] Building upon Figures 5.29, 6.9 and 7.35 that summarised the key findings of each of the three research methods

| Table 8.3: Summary of main research findings:<br>Methods of assessment of scale and scale effects |
| --- |
| There is a **difference between how people convey landscape qualities and sensitivities to scale within planning responses** and how they convey these through experiential landscape assessment and public attitude and preference studies. |
| People's **estimations of wind turbine size and distance are inaccurate** and do not correspond to their **observation of windfarm scale effects,** so dimensions should not be used to convey scale effects. |
| People's perception of scale and scale effects is influenced strongly by a **range of scale perception processes and cues,** eg scale constancy, linear perspective, figure-ground and motion parallax. Thus these need to be taken into account when assessing potential scale effects (and not only those known most commonly such as linear perspective). |
| A combination of **professional assessment and semi-structured interviews** can identify the key characteristics of a landscape sensitive to scale and aid understanding of how scale effects will affect people's experience of a landscape and for what and why they value this. A great deal of information can be gained through **participatory consultation** but, as consultees are typically unfamiliar with analysing and conveying issues of scale, scale effects and landscape experience, this requires significant preparation as well as facilitation and guidance during the process. |
| It is useful to carry out **participatory consultation with both local residents and local planning and landscape professionals**. Although these identify many of the same aspects, they tend to convey these in different ways, leading to more in-depth understanding in combination. |
| **LVIA** can be used to assess the scale effects of a windfarm, but it **needs to include thorough assessment of the experience of the landscape by people and the sensitivities to scale,** or be supplemented by an experiential landscape assessment |
| There is a **range of sensitivities to scale of a landscape and how this is experienced** that need to influence siting and design of a windfarm to minimise scale effects and be assessed through LVIA |
| Conjoint analysis is a very useful method to understand the **relative importances of attributes** that influence people's perception of scale effect (as well as other landscape and visual effects) which they may not be aware of. |
| Scale is often described ambiguously and inconsistently. **When describing scale, it is is important to define what is meant** given this is a relative quality and, importantly, there is a difference between visual and spatial scale and different types of scale reference used. Some words for scale effects are used in a more discriminating way than others and these should be used whenever possible. |
| **Design aims and thresholds for scale effects are usually described ambiguously and, instead, should be defined clearly,** eg with what compatibility is desired and what is meant by terms such as 'in scale'. |
| **Photographs or visualisations based upon these are poor at representing our perception and experience of scale and scale effects** when off site (even if meeting the best technical standards) and thus judgements of perceived scale and scale effects are best made on site. Hand-drawn sketches or diagrams may help convey to others what is most important to the perception of scale and scale effects such as distance cues. |
| There is no simple answer to the question of what scale a windfarm should be in a certain landscape. Nonetheless, it is possible to **highlight the issues that need to be considered** when siting and designing a windfarm to minimise scale effects, or when assessing the effects of a proposal. To aid this process, prompt lists may be useful. |

| Table 8.4: Summary of main research findings:<br>How scale and scale effects are perceived and experienced in the landscape and their importance |
|---|
| **How people perceive scale and scale effects in a landscape** |
| • People **use different processes and cues to perceive scale**.<br>• There is a difference between **visual scale and spatial scale** in a landscape and both are important.<br>• **There are different ways in which people make scale references**: reference to a measure; reference to what is considered normal; and reference to another object or space.<br>• People **judge scale in relation to different things in different circumstances,** influenced by the availability of scale references and their proximity and similarity of scale.<br>• People's perception of windfarm scale is influenced by **cultural factors, aesthetic proportion systems, symbolism and public attitudes to windfarms.**<br>• ACBC respondents revealed a **high consistency of judgement of what attributes and levels are most important to a perception of scale effects.** |
| **Attributes more important than predicted to people and their perception of scale and scale effects** |
| • People's perception of a landcape reflects a **composite of different experiences**, gathered via different places, different activities and at different times. Within this context, people **judge the scale of one element or place in relation to others**.<br>• **Journeys** inform perception of scale (speed and time acting as a cue for distance) and are particularly important when passing or crossing landscapes without obvious distance cues.<br>• **Reference points or landmarks** help people 'place' themselves and other elements in a landscape and thus inform scale perception.<br>• **Hills and horizons** provide important edges and backdrops, defining places and their scale.<br>• **Vantage points** provide important views that aid legibility of the scale of the landscape.<br>• Opportunities to **'feel on top of the world'** are important to people's experience of scale.<br>• **The everyday landscape experience** for those that work and live within an area is very important, including **'low-key' recreation** such as dog walking, and **local trips** to work or school. |
| **Unexpected research findings or those contrary to current understanding or practice** |
| • **Proximity is the attribute with highest relative importance for people's judgement of an overbearing scale effect**, followed (in order) by windfarm size, wind turbine size, context of experience and landscape type.<br>• **Perceived spatial separation** has a strong influence on perceived scale effects, with a higher than expected sensitivity identified for open landscapes such as moorland.<br>• **Wind turbines** with longer blades related to tower height are judged to have greater scale effect.<br>• People judge scale effects upon the wider landscape and community to **result collectively from a combination of scale effects upon individuals or local spaces and residences**.<br>• People's perception of scale effect is based upon the **spatial characteristics around both the viewer and the structure**, which may be different in character.<br>• The scale effects of wind turbines are influenced by object recognition, so **scale effects are not necessarily reduced if wind turbines are partially screened.**<br>• Perceived importances for **wind turbine size and numbers are not correlated** for scale effects (ie fewer large wind turbines do not have equivalent effect to additional small wind turbines).<br>• **Changes to the scale of a windfarm result in different amounts of change to scale effects,** depending on where thresholds occur, eg change from a medium to a large size windfarm results in greater difference in scale effect than change from a small to a medium size windfarm.<br>• **A windfarm may have overbearing scale effects even if it is difficult to perceive scale in a landscape**, eg across moorland, hills or water, as the viewer is unsure how far away the windfarm is and judges the scale effects directly upon them.<br>• People experience **windfarm effects to constantly change,** reflecting changing light and weather. |

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**The perception of scale and scale effects in the landscape,**

**with specific reference to wind turbines in Scotland**

Caroline Stanton

# Thesis Appendices

Doctor of Philosophy

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## Appendices

The following section comprises appendices to the thesis, structured to follow the individual chapters of the thesis.

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# APPENDICES A

## *Chapter 1: Research background and problem statement*

## Appendix A.1: Glossary of terms

The following glossary describes key terms adopted by this thesis. Where possible, these have been reproduced from the Guidelines for Landscape and Visual Impact Assessment (GLVIA) produced by the Landscape Institute and IEMA (3rd edition, 2013) or other publications, as noted by an asterisk and referenced at the end.

| *Term* | *Description* |
|---|---|
| Aesthetic | This is defined by the Oxford English Dictionary (2012) as 'concerned with beauty or the appreciation of beauty' or 'having a pleasant appearance'. With regards to scale in landscape architecture, the word aesthetic tends to be used in relation to application of relationships and proportions of scale that are recognised as having aesthetic qualities linked to perception of harmony and balance. |
| Anemometer mast | A mast erected to measure wind speed. Within a windfarm, this is usually the same height as the wind turbine nacelle, but not always. |
| Baseline | The environmental conditions against which any future changes can be measured or predicted and assessed.*[1] |
| Characteristics | Elements, or combinations of elements, which make a contribution to distinctive landscape character.*[1] |
| Collective effects and cumulative effects | 'Collective effects' is used to describe effects that result from the combination of more than one individual effect. These are described differently to 'cumulative effects' which tend to be associated with the effects of more than one development, defined as '…additional changes to the landscape or visual amenity caused by the proposed development in conjunction with other developments…' *[1] |
| Development | Any proposal that results in a change to the landscape and/or visual environment.*[1] |
| Effect | The change resulting from an impact (within LVIA)*[1] |
| Element | Individual parts which make up the landscape, such as, for example, trees, hedges and buildings.*[1] |
| Feature | Particularly prominent or eye-catching elements in the landscape, such as tree clumps, church towers or wooded skylines OR a particular aspect of the project proposal.*[1] |
| Impact | The action being taken (within LVIA)*[1] |
| Key characteristics | Those combinations of elements which are particularly important to the current character of the landscape and help to give an area its particularly distinctive sense of place.*[1] |
| Landscape | An area, as perceived by people whose character is the result of the action and interaction of natural and/or human factors*[2] |
| Landscape and Visual Impact Assessment (LVIA) | A tool used to identify and assess the likely significance of the effects of change resulting from development both on the landscape as an environmental resource in its own right and on people's views and visual amenity.*[1] |
| Landscape character | A distinct, recognisable and consistent pattern of elements in the landscape that makes one landscape different from another (rather |

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| | than better or worse).*[1] |
| Landscape Character Assessment (LCA) | The process of identifying and describing variation in the character of the landscape, and using this information to assist in managing change in the landscape. It seeks to identify and explain the unique combination of elements and features that make landscapes distinctive. The process results in the production of a Landscape Character Assessment. *[1] |
| Landscape Character Types (LCT) | These are distinct types of landscape that are relatively homogeneous in character. They are generic in nature in that they may occur in different areas in different parts of the country, but wherever they occur they share broadly similar combinations of characteristics, including those that are perceptual. *[1] |
| Landscape effect | Effects on the landscape as a resource in its own right*[1] |
| Landscape type | This is a generic term to describe a landscape that can be identified by a distinct combination of characteristics, but does not necessarily fit with the distribution of defined landscape character types (described above), for example because of being identified at a broader scale or in relation to a specific aspect. |
| Landscape value | The relative value that is attached to different landscapes by society. A landscape may be valued by different stakeholders for a whole variety of reasons.*[1] |
| Magnitude (of effect) | A term that combines judgements about the size and scale of the effect, the extent of the area over which it occurs, whether it is reversible or irreversible and whether it is short or long term in duration. *[1] |
| Modest scale effect | This is a term to describe a low level of scale effect, identified through this research (Chapter 7). In this context, 'modest' is defined as unassuming, discreet or minor. It occurs where an element appears similar or smaller in scale to other elements within the surrounding landscape and/or those judged as normal and its presence is perceived as modest in either visual or spatial scale or upon the experience of the landscape and its qualities and value perceived by people. |
| Natural beauty | A composite term that refers to those qualities of the landscape that appear to all our senses, but particularly the visual. The use of the word natural does not exclude landscapes or features which result from, or are changed by, human activity – a canal for instance may have considerable natural beauty and amenity.*[3] |
| Overbearing scale effect | This is a term to describe a high level of scale effect, identified through this research (Chapter 7). In this context, 'overbearing' is defined as overpowering or domineering. It occurs where an element appears larger in scale to other elements within the surrounding landscape and/or those judged as normal and its presence is perceived as overbearing in either visual or spatial scale or upon the experience of the landscape and its qualities and value perceived by people. |
| Perception | Combines the sensory (that we receive through our senses) with the cognitive (our knowledge and understanding gained from many sources and experiences).*[1] |
| Photomontage | A visualisation which superimposes an image of a proposed development upon a photograph or series of photographs.*[1] |
| Prominence/ prominent | Prominence refers to the state of being prominent; whilst prominent refers to something being particularly noticeable or 'sticking out'. |
| Receptors | Receptors are aspects of the landscape resource or individuals and/or defined groups of people who have the potential to be affected by a |

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| | proposal. |
| Sanctuary | This refers to a sense of retreat, influenced by distance from and/or little evidence of disturbance. Areas with perceived sanctuary often also have qualities of tranquillity. This meaning is different to alternative uses of the term as a place of safety. |
| Scale | Scale is a word that can be used in a multitude of different ways but, in the context of this research, it is used to mean relative size or extent. It is a quality that exists in relation to something else, which may be one of the following: a unit of measure, for example a metre; an object, such as a person, tree or building; or in relation to what we consider as normal. |
| Scale effect | Scale effects are those effects that arise from the scale of something (following the definition of scale above). Within the context of this research, the definition of effects is taken from GLVIA3 (Landscape Institute and IEMA, 2013, pp8-9) and a scale effect is defined as a change arising from the scale of a development. |
| Scenic quality | The aesthetic value placed on the landscape, based primarily on the visual senses. This value is not absolute and tends to reflect prevailing ideas about which landscapes offer a particular aesthetic.*[3] |
| Sensitivity (of landscape or visual resource) | A term applied to specific receptors, combing judgements of the susceptibility of the receptor to the specific type of change or development proposed and the value related to that receptor. *[1] |
| Significance (of effect) | A measure of the importance or gravity of the environmental effect, defined by significance criteria specific to the environmental topic.*[1] |
| Spatial scale | This refers to the scale of the landscape in terms of its spatial characteristics, typically responding to the extent of a space in relation to the height, steepness and form of its edges and the scale and distribution/ position of elements within the space. Spatial scale influences perception of openness or containment, and exposure or intimacy. |
| Tranquillity | A state of calm and quietude associated with peace, considered to be a significant asset of landscape.*[1] |
| Visibility | This refers to an ability to see or for something to be seen. The nature of visibility refers to what can be seen; whilst the extent of visibility refers to where something can be seen. Importantly, although visibility influences visual effects, there is not a direct relationship between visibility and visual effects. |
| Visual amenity | The overall pleasantness of the views people enjoy of their surroundings, which provides an attractive visual setting or backdrop for the enjoyment of activities of the people living, working, recreating, visiting or travelling through an area.*[1] |
| Visual effect | Effect on specific views and on the general visual amenity experienced by people*[1] |
| Visual scale | This refers to the scale of an element seen within a view, for example the relative scale of a line in relation to a shape. Within the context of this research, the term visual scale is used to describe the perceived visual scale of one element in a landscape in relation to another; and does not take into account spatial scale (see above). It is a quality influenced by visual perception so the visual scale of one element in relation to another does not necessarily reflect the physical sizes of these. |
| Visualisation | An image such as a computer simulation, photomontage, sketch or drawing that illustrates the appearance of an element or composition. |

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| Wild Land | Extensive areas where the quality of wildness (see below) is best expressed. Uninhabited and often relatively inaccessible countryside where the influence of human activity on the character and quality of the environment has been minimal. |
| Wildness | This term refers to a quality experienced by people resulting from the presence of the physical attributes of perceived naturalness, a lack of modern artefacts and little evidence of contemporary land use, a rugged or physically challenging landform, and remoteness and inaccessibility. These result in perceptions of a sense of sanctuary, risk, awe or anxiety, arresting and inspiring qualities, and fulfilment from physical challenge.*[4] |
| Windfarm | For this research, this term is used to describe one or more wind turbines developed as a single scheme (see section 3.3 for further information). |
| Zone of Theoretical Visibility (ZTV) | A map (usually produced digitally) showing areas of land from which a development is or would be theoretically visible. |

*[1]Taken from GLVIA (3rd edition)
*[2] Taken from Council of Europe, 2000
*[3] Taken from SNH (2001b) *Landscape Policy Framework: Policy Statement No 05/01*.
*[4] Taken from SNH (2002) Wildness in Scotland's Countryside: A Policy Statement.

## Appendix A.2: Acronyms included in the thesis

| *Acronym* | *Name* |
|---|---|
| AOD | Above Ordnance Datum |
| GLVIA | Guidelines for Landscape and Visual Impact Assessment (produced by The Landscape Institute and the IEMA). GLVIA2 refers specifically to the second edition (2002) and GLVIA3 refers specifically to the third edition (2013). |
| IEMA | Institute of Environmental Management and Assessment |
| km | Kilometre |
| LCA | Landscape Character Assessment |
| LIA | Landscape Impact Assessment |
| LVIA | Landscape and Visual Impact Assessment |
| m | Metre |
| MW | Megawatt |
| NSA | National Scenic Area |
| PLI | Public Local Inquiry |
| SNH | Scottish Natural Heritage |
| VIA | Visual Impact Assessment |
| ZTV | Zone of Theoretical Visibility |

## Appendix A.3: Common features to which scale reference is made in the UK

| *Landscape feature* | *Height* | *Image* |
|---|---|---|
| **Scott Monument, Edinburgh** | Height to top of finial: **61.1m** |  |
| **Arthur's Seat** | 251m AOD (base approximately 40m AOD on north side), so approximately **211m** visible height |  |
| **Edinburgh Castle** | Castle Rock **130m** AOD, with rocky cliffs 80m high. |  |
| **Angel of the North** | **Height 20m, Span 54m** |  |
| **London Eye** | **135m** |  |
| **Big Ben** | **96.3m tall** |  |

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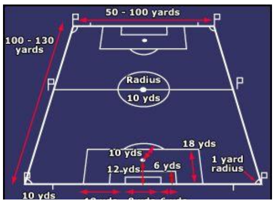
|---|---|---|
| **Nelson's Column** | **51.59m tall** |  |
| **St Paul's Cathedral** | **111m max height.** Dome height (external) = 85m. Length = 158m and width across transepts = 75m. |  |
| **Canary Wharf (One Canada Square)** | Pinnacle of pyramidal roof **235m** above ground level, 245.8m AOD. The pyramid roof itself is 40m high. |  |
| **Shard London Bridge** (also known as 'London Bridge Tower' and 'Shard of Glass') | **310m to top of tower** |  |
| **Emley Moor transmitting station** | **330.4 m max height.** Tower room = 274m high. Antenna structure = 56m high. Top of tower is 594m AOD. |  |
| **Wallace monument** | **67.5 m** to top of monument. Abbey Craig approx 111m (surrounding ground about 10m). So feature in total about **157.5m.** |  |

| | | |
|---|---|---|
| **Stirling Castle** | Hill on which castle is built = 105m AOD (surrounding ground about 20 m). Height of tallest part of the castle (The King's Old Building) = 125m AOD. So feature in total **105m** high |  |
| **Tate modern** | Chimney **99m** to top. Building 200m long. |  |
| **The White Horse at Ebbsfleet** | **50m** to tip of ears. |  |
| **Other size comparisons commonly cited** | | |
| **Football pitch** | Variable size, between **90 – 120m** long, 45-90m wide |  |
| **Double-decker bus** | Typically 9.5 – 11m long, **4.38m high.** |  |
| **Elephant** | **Between 2.3m** (Sumatran Elephant) **and 3.5m** (African Bush elephant). |  |

## Appendix A.4: Bibliography (excluding references)

This bibliography includes a list of publications that were referred to during the research, but were not referenced directly within the thesis. Consequently, to understand the full range of publications relevant to this research, it is necessary to consider this bibliography in addition to the references included at the end of the thesis report (p281-292).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## Appendix A.5: Estimation of wind turbine size and distance

During the research background and consultation, the researcher heard repeated reference that the perceived scale of windfarms did not correspond with the actual scale of windfarms. If this was true, in reverse, it would mean that describing windfarms in units would be unlikely to result in an accurate prediction of the perceived scale of a windfarm and thus the predicted scale effects of this. This suggestion was not surprising given relevant theories of visual perception which highlight how perception of size and distance varies in relation to different contexts (Canter, 1974), and that it is particularly difficult to estimate the size of large structures such as wind turbines that do not have a direct human scale reference. Indeed, Tavernor (2007, p10) highlights: *'By using numbers and symbols as the principal language to relate abstract and concrete ideas ...difference in qualities have been turned into abstract scientific quantities...incomprehensible to and remote from everyday human experience'.*

Although the hypothesis that people's perception of the scale of windfarms does not correspond with the actual scale of windfarms had been quoted by many consultees, the researcher could find no empirical evidence to prove or disprove this. She thus felt it would be useful to run an exploratory study to test the hypothesis to understand better the problem statement for this research, although this would not directly address the research questions.

To test the hypothesis, a public survey was undertaken at the existing Whitelee windfarm, East Renfrewshire. With the agreement of the owners of the visitor centre, Scottish Power Renewables, visitors to the windfarm visitor centre and/or the windfarm walking and cycling tracks were questioned over one weekday in June (between 10:00 and 18:00).

### *Method*

Two locations were selected near to the visitor centre where the windfarm could be seen: just outside the door to the centre; and by the gate leading from the car park to the tracks used by people for walking and cycling[1]. People passing these spots were invited by the researcher to participate in the survey and, if willing, were asked four quick and simple questions, as included in Table A.5.1 overleaf. Once the data from their responses had been collected, this was compared to the actual dimensions of the windfarms to determine the differences between estimated size and distance and actual size and distance.

[1] Grid references: Visitor Centre, 252918, 649045; gateway to tracks, 253034, 649029.

| Table A.5.1: Questions to assess people's estimation of windfarm size and distance | |
|---|---|
| *Question* | |
| 1 | How high do you think the wind turbine is to the tip of the blade when it is at its highest? |
| 2 | How far do you think the closest wind turbine is? |
| 3 | How far do you think are the furthest wind turbines visible? |
| 4 | Have you visited here before? (to test familiarity with the location and development) |

### *Findings*

Forty people responded to the survey. Personal or demographic information was not requested for the survey to encourage involvement (both due to not needing to pass on personal information and to be quick to answer). Consequently, it is not possible to confirm whether the respondents were representative of the wider population of Scotland. In addition, as the survey was carried out on only one day, the respondents are unlikely to be representative of all visitors to Whitelee windfarm over a year. Nonetheless, the respondents were representative of those that visit the windfarm during summer for a range of activities, from visiting the Visitor Centre exhibition and/or café, and walking and cycling along the windfarm tracks. Twenty nine of the respondents (72% of the total) had visited the location previously and thus had previous experience of seeing and passing the wind turbines, whilst 11 (28%) were visiting for the first time.

The data were input into an Excel spreadsheet. Answers that were +/- 100% from the correct dimensions were omitted as these were found to disproportionately distort the findings, especially as some were out by as much as 1500%.

The following section summarises the findings for the three questions.

*Wind turbine height*

The wind turbine that formed the subject of the question was 110m high to tip. Estimations of its height ranged from between 15m high and 700m high[2], representing an error between – 95m (-86.4%) and +590m (+536.4%). A graphic representation of the responses[3] is shown in Figure 1.2 of the main thesis report. This indicates that the responses were widely dispersed.

Nine of the 40 respondents estimated the height of the wind turbine within +/- 20% of the actual dimension, which represents 22.5% of all respondents.

*Wind turbine proximity*

The distance of the wind turbine that formed the subject of the question was 345m or 307m (differing between the two survey points). Estimations of its distance ranged between 91m away and 1000m away[4], representing an error between – 254m (-82.7%)

[2] Dimensions in feet or metres were accepted and all converted to metres.
[3] Omitting responses +/- 100% to reduce distortion
[4] Dimensions in feet, yards or metres were accepted and all converted to metres.

and +693m (+225.7%). A graphic representation of the responses[5] is shown in Figure 1.3 of the main thesis. This indicates that the responses were widely dispersed.

Seven of the 40 respondents estimated the distance of the wind turbine within +/- 20% of the actual dimension, which represents 17.5% of all respondents.

*Far distance of windfarm*
The far distance of the windfarm that formed the subject of the question was 10 km. Estimations of its distance ranged between 1km away and 100km away[6], representing an error between – 9km (-150.0%) and +90km (+1500.0%). A graphic representation of the responses[7] is shown overleaf in Figure A5.1. This indicates that the responses were dispersed, but with more negative than positive in difference. In addition, the data reveal that a fairly high number of respondents (*n=14*) estimated -33% of the actual distance. Although this may appear to indicate a remarkable level of consistency, it is most likely to derive from the fact that -33% equates to an estimated 'round number' of 5 miles distant.

Three of the 40 respondents estimated the height of the wind turbine within +/- 20% of the actual dimension, which represents 7.5% of all respondents.

[5] Omitting responses +/- 100% to reduce distortion
[6] Dimensions in km or miles were accepted and all converted to km.
[7] Omitting responses +/- 100% to reduce distortion

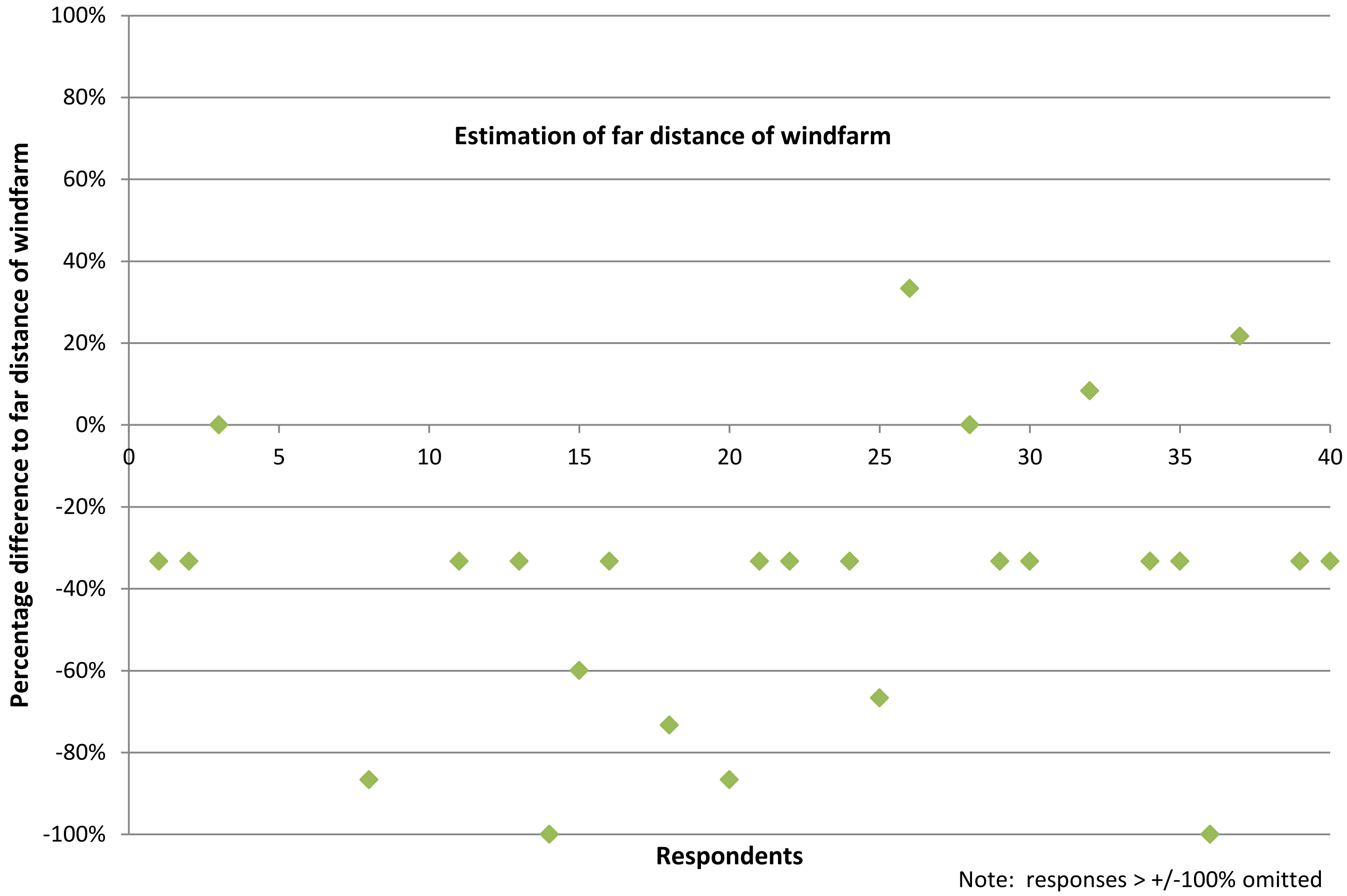


Figure A.5.1: Graph showing difference of estimations of the far distance of the windfarm compared to actual far distance of the windfarm

## Appendix A.6: Review of responses and representations to planning applications for windfarms

This stage of the background research involved review of a sample of planning reports, consultation responses, community representations and published articles (*total n=18*) made for planning applications (including Section 36 applications[8] and planning appeals). These were made by members of the public, Scottish Natural Heritage (SNH), Local Planning Authorities, Community Councils, Scottish Government and journalists/writers. The criteria for this review are listed in Table A6.1 below:

| Table A.6.1: Criteria for review of responses and representations made for planning applications for windfarms | |
|---|---|
| General | Type of proposal and the landscape and visual context |
| 1 | The range and type of characteristics relevant to scale and the scale effects identified |
| 2 | Judgement of magnitude and/or significance of scale effects and acceptability |
| 3 | For what do people value the landscape and why is it important to them? |
| 4 | How would the scale effects affect the perceived importance or value of the landscape? |
| 5 | How do people convey their perceptions, behavioural responses and/or judgements of scale effects? |
| 6 | Was mitigation of the scheme suggested and, if so, what was the threshold for change of effect? |
| 7 | Was there explanation or rank of the relative importance of scale effects in relation to other effects? |

The responses reviewed for this stage were selected to represent different scale effects and how these had been described in different ways by different people for different schemes. They were identified following background research and by consultees during the LVIA method.

### *Findings*

The following section summarises the key findings of the review of responses and representations made for planning applications with regards to scale effects. Although all of the information from the review is relevant to the research, the findings for criteria 1, 2 and 6 were most relevant to the LVIA method, criteria 3-5 most relevant to the experiential landscape assessment method, and criterion 7 most relevant to the public attitude and preference study method.

Through the review of responses to and representations of windfarm proposals it was found that these differed greatly in relation to their purpose and by whom they were written. With regards to scale effects, the only consistent information provided was quantitative: the size and numbers of wind turbines, and some also highlighted the distance of these from some key locations. The responses from community councils were found to be most variable, with many very brief, even when objecting to a scheme, although some

[8] Applications are made to the Energy Consents and Deployment Unit for windfarms with a capacity in excess of 50 megawatts

included more detailed information.  This variation may reflect differences in the knowledge and skills of members of different community councils, as they draw people with different backgrounds.  Nonetheless, the hesitance evident in some responses and representations also suggest that some were having to represent different opinions within the community or between council members.

Media articles written about the scale effects of windfarms also varied in content and quality.  Journalists reporting events or planning decisions were found, unsurprisingly, to typically focus on the facts of scheme and then quote applicants, planners and local people.  In contrast, writers' essays or articles tended to be more descriptive, particularly with regards to the characteristics and qualities of the landscapes and the emotional responses of different people to scale effects.

Planning reports prepared by consultants, as expected, were found to be focused on specific aspects of a scheme and follow standard professional methods.  Nonetheless, these documents typically limited their description of scale effects to visual scale effects and not spatial or experiential effects.  In comparison, reports by council planning officials were found to consider a wider range of issues and thus typically touched on few in any great detail, including scale effects.  Nonetheless, they typically included a summary of the main concerns of local people and objectors which was sometimes the scale of the proposal.

In contrast to the reports and articles described above, PLI reports by Scottish Government Reporters tended to address scale effects in more detail: both visual and how these would be experienced by the local population.  This followed their unique opportunity of being able to combine the information within technical documents from professionals with hearing the verbal evidence of local people (who may not have been able to convey scale effects in writing) and also considering this evidence whilst assessing a scheme on site.

From analysis of the responses to and representations of planning applications, the following section describes the main findings with regards to the criteria listed in Table A.6.1.

### *Range and type of characteristics described that are relevant to the scale of the landscape and the scale effects of the proposal*

The review of responses to and representation of planning applications found that, even when the scale of the windfarm formed part of a headline for objection, there was typically little information provided on the sensitivities of scale and the nature of the scale effects of the proposal.  In contrast, most responses seemed to rely on a judgement of scale effects being made by the reader based on the provision of information on the location of the proposal[9] and a description of it in terms of the height and number of wind turbines and their distance from one or a few named locations, with little or no interpretation provided within the documents.  When scale effects were mentioned, these tended to be fairly general in nature, such as the scale of the development being too large in relation to the

[9] Interestingly, the community responses seemed to include less information on the landscape characteristics; perhaps because they assumed knowledge of this.

landscape. Nonetheless, some responses and representations included slightly more information such as:

a The scale of a development in relation to the landscape pattern, landform and/or specific landscape features;

b The scale of the windfarm in relation to key visual receptors, such as residents or walkers along core paths, but only in terms of wind turbine height, number and distance;

c The proportion of wind turbines visible, typically with no explanation of what this would mean in terms of scale effects, but it was implied that a smaller proportion seen would have reduced scale effect;

d Cumulative scale effects with other windfarms as influenced by compatibility of extent and wind turbine size; and

e The extent of a windfarm in relation to an undeveloped skyline visible.

Some of the responses and reviews described the difference of the scale effects from distant views and close-up views and some also mentioned the relative elevation of the viewer in relation to the windfarm, but this information was rare. More common was description of scale effects in relation to other windfarms (cumulative effects) which may indicate that people found it easier to describe effects in relation to another windfarm because this provided a scale and location reference.

Most references to scale effects referred to aspects of visual scale, rather than the effects of scale on the spatial characteristics of the landscape and/or how this was experienced. This absence of information seemed particularly notable for the community responses, as it would be expected that members of the community would possess invaluable information on these aspects. Notably, this also contrasted to some responses from individual residents who were more forthcoming in explaining how a windfarm would affect them at their residence spatially and experientially. This raises the possibility that, whilst a community is aware of these effects from individual locations, they feel they do not have the ability, confidence or mandate to be able to highlight common scale effects upon their community council area as a whole.

### *Judgement of the magnitude and/or significance of scale effects and how this affects the judgment of acceptability of a scheme*

Through the review of responses to and representations of planning applications, it was found that different levels of magnitude or significance of landscape and visual effects, including scale effects, were identified rarely except by landscape professionals and, to a lesser extent, PLI Reporters and council planners. In contrast to the standard process of EIA, most of the responses alternatively seemed to focus upon only those scale effects that were judged as significantly adverse and these were described using terms such as: ‘discordant’, ‘dominant’, ‘incompatible’, ‘overbearing’, ‘overwhelming’ or ‘disproportionate’. Throughout the review process, definition of these terms was rarely found (described within section 7.1 of the main thesis) and thus it was left to the reader to judge the likely level of these and their relevance and importance. This made it typically difficult to understand the link between the significance of individual effects and judgements of overall effect and the acceptability of this, although PLI Reporters and planning officials nonetheless made this judgement due to their decision-making responsibility. Sometimes, they expressed this using tests such as a development being 'out of scale' or whether a place remained 'attractive' to live in although, without definition of these tests either, these judgements were typically ambiguous.

For the responses and representations reviewed, it was often unclear whether some were describing effects on other elements of the landscape or directly upon the people viewing and experiencing a scheme, although some terms implied the latter, such as 'disturbing'. Alike the findings described in the previous section, it was found that responses by a community seemed to be more confident in describing the effects of a scheme, such as 'too large, too many and too close', than how this would affect the landscape or people within an area (the receptors). Alternatively, confirmation of a judgement of significance was sometimes made via agreement with other consultees' responses, such as by SNH or Historic Scotland.

### *What people value in the landscape and why is it important to them*

The review of responses to and representations for planning applications found that, generally, people provided very little information regarding the value of the landscape and why it was valued and some responses included no information on this at all. It was not unexpected that professionals' reports would not highlight this aspect and would, instead, focus upon the assessment of value in relation to statutory landscape designations. Nonetheless, it was more surprising that this kind of information was not provided by representatives of local communities. When these identified the value of a landscape, they tended to highlight either very generic qualities such as 'scenic qualities' or the value of specific features or services, such as the use of specific pathways or a long distance route within an area. This could be because the community representatives lacked the confidence of describing landscape value and were concerned that this information would be taken as too subjective; or they may have not realised that these values, which are very familiar to them as local residents, needed to be highlighted for others.

Where information on landscape value was included within the responses and representations, this included mention of the following values:

- Scenic qualities;
- Enjoyed for recreation (including ease of access to this), both of local people and tourists, including for walking and enjoyment of a 'peaceful environment' and linked to heritage features;
- Hills which are valued for the views these offer and their landmark qualities, as well as foothills to larger hill ranges;
- Absence of development and infrastructure and a perception of tranquillity and/ or remoteness.

Whilst the authors of articles sometimes mentioned the economic value of a development, this seemed to be mentioned rarely by local communities except negatively in relation to the loss of value for tourism. Nonetheless, this might be influenced by windfarms being perceived as being incompatible with tourism, but not other economic land uses or activities.

### *How scale effects affect the perceived importance or value of a landscape*

Through the review of responses to and representations for planning applications, it was found that most of these included very little or no information on the scale effects of a development specifically in relation to characteristics of the landscape that were valued. This was not unexpected given that there was little information provided on the baseline in this respect, as discussed within the section above, to which predicted scale effects would need to be judged.

Where responses and representations did include description of scale effects on the importance or value of the landscape, these included mention of the following:

- Reduced expansive qualities of moorland; and
- Perceived intrusion upon the enclosed qualities of 'a scenic glen'.

Nonetheless, many effects were described too imprecisely to be sure whether these reflected scale effects and also, specifically, whether they would affect characteristics that would influence the value of the landscape. For example effects described in this way included the following:

- Cumulative effects with other windfarms upon the experience of specific walks within the landscape;
- The proximity of a windfarm reducing residential amenity;
- Adverse effects on recreation and tourism and
- Reduced value of a landmark feature.

In addition, some descriptive words were included within some responses and representations that may reflect the assessment of scale effects on aspects of the landscape that are valued, but not necessarily, such as: 'distracting'; 'disturbing'; 'vast'; and 'overwhelming'.

### *How people convey their perceptions, behavioural responses and/or judgements of scale effects*

Generally, there was little or no information included within most of the responses to and representations for planning applications regarding people's perceptions, behavioural responses and how they judged scale effect. Rather, people more commonly just gave a judgement of acceptability. In addition, when people did mention perceptions, they tended to describe these just in relation to specific places, such as a particular walking destination or visitor attraction.

One of the reasons for little information on perceptions and behavioural responses may have been that people had difficulty conveying this information. This would account for why some people included imprecise references such as a place having a 'special atmosphere' and 'spirituality'.

With regards to a judgement of the acceptability of scale effects, many representatives of community councils seemed to refer to a judgement of consensus or majority in the community with regards to support or opposition, rather than actually describing the nature of the effects predicted. In addition, they tended to describe attitudes to the windfarm as a single collective feature, rather than drawing out the different effects of different attributes that influence scale effects. Similarly, professionals rarely described how the scale effects of a scheme would be perceived or what behavioural responses they would prompt and, instead, made judgements of acceptability in relation to published good practice guidance or policy which may or may not take these factors into account. The exceptions were PLI Reporters who seemed to consider in more detail people's perceptions, likely behavioural responses and judgements of effects, in reference to the contents of technical reports, hearing evidence from professionals and local people, and also their own site assessment. Nonetheless, whilst these Reporters summarised their findings of this analysis within PLI reports, they limited the information provided in relation to the scope of relevant planning policies.

### *Suggestions for mitigation of schemes and, if included, the threshold for changes of effect*

Through the review of responses to and representations for planning applications, it was found that most did not suggest mitigation of scale effects identified, although a few referred to design options and potential mitigation measures identified within LVIA reports. For some schemes, where thresholds of effect were identified, there was a difference of opinion between community councils and the planners. For example, one council set a threshold of all wind turbines needing to be under 80m high within a particular landscape, but the community council remarked that this was much too high to mitigate effects to an acceptable level.

### *Explanation or rank of the relative importance of scale effects in relation to other effects*

For most of the responses to and representations for planning applications reviewed, it was found that scale effects were not distinguished from other landscape and visual effects, although these indicated (through reference to windfarm details) that the scale of a development was taken into account when predicting its potential effects. For example, responses often highlighted the size and numbers of wind turbines and the effects of these in views from nearby settlements, but they would not distinguish the scale effects from any of the other landscape and visual effects such as prominence. The main exceptions to this finding was for schemes for which the scale of the development was a distinguishing factor (for example, the highest wind turbines at the time proposed within the region) and, in these cases, both the community and professionals highlighted specific scale effects for example having an imposing effect on nearby houses.

## Appendix A.7: Alternative methods for producing visualisations suggested by critics of standard guidelines[10]

Following frustration with the representation of windfarm scale effects by visualisations, some practitioners and people opposed to windfarms (for example Architech Animation Studios, 2007; Highland Council, 2010) believed that increasing the size of a windfarm within an image (by reducing the horizontal and vertical field of view, effectively 'zooming in' and cutting out the margins of the view) would represent better the perception of scale effects. This was in contrast to Bell (2005) who describes how our perception of scale is strongly influenced by our field of view (p142), so it is not just the size of elements that is important, but also the setting in which they are seen. When assessing the alternative visualisations in the field, these posed no great disadvantage (or advantage), as the images could be matched to the scene beyond (by adjusting the viewing distance) and thus the context of the images could be seen in reality. Nonetheless, when observing these visualisations offsite, their omission of foreground, sky and other contextual information meant that it was even more difficult to perceive the scale effects of the windfarms shown, as there were fewer elements that could be used as cues for perceiving scale in direct relation to the viewer. This is supported by Rogers (1995) who states that most researchers have found that perceived pictorial depth is underestimated relative to perceived real depth and that this may be because pictures omit some of the optic array that provides information on distances to elements and surfaces.

In addition, in an attempt to address the difference between two-dimensional images and people's experience of windfarms on site, some guidance (for example Architech Animation Studios, 2007) advised people to match the way in which the landscape was viewed to the limitations of the image, rather than the other way around, recommending that the landscape should be viewed with just one eye open. Following this advice, the benefits of stereopsis was removed (Heeger, 2006) and it was even more difficult to perceive scale using the visualisations.

[10] Produced by: SNH, 2006 and 2014b; The Landscape Institute, 2011.

# APPENDIX B
## *Chapter 2: Theoretical background*

### Appendix B.1: Dictionary definition of scale

The Oxford English Dictionary (2012) provides definitions for six different ways in which we use the word scale as below:

a 'A range of values forming a system for measuring or grading something: *a pay scale*;

b A measuring instrument based on such a system;

c The full range of different levels of people or things, from lowest to highest: *opposite ends of the social scale*;

d Relative size or extent: *he operated on a grand scale*;

e A ratio of size in a map, model, drawing or plan;

f An arrangement of the notes in a system of music in ascending or descending order of pitch.'

# APPENDIX C

## *Chapter 3: Methodology framework*

### Appendix C.1: Location of case studies

Figure C.1.1: Study area for Case Study A: Dalswinton, Nithsdale, Dumfries and Galloway (representing an area with an existing windfarm)


0 10 km

Study area

Figure C.1.2: Study area for Case Study B: Druim Ba, near Abriachan, Inverness-shire (representing an area with a proposed windfarm)




0 10 km

Study area

Figure C.1.3: Study area for Case Study C: North Mull (representing an area with neither an existing or proposed windfarm)


0 10 km

Study area

## Appendix C.2: External consultees or participants

The following table lists the number of external consultees that discussed or provided comment, guidance or feedback on the research (not including participants for the public attitude and preference study questionnaires).

| Table C.2.1: Numbers and types of external consultees for the research | |
|---|---|
| | *number* |
| Professionals involved with the landscape and/or windfarms | 31 |
| Professionals involved with other technical considerations (eg meteorologist) | 4 |
| Subtotal professionals involved with research excluding case studies | 35 |
| Case study professionals involved with the landscape and/or windfarms | 15 |
| Case study members of community councils and the public | 41 |
| Subtotal people involved with the case study research | 56 |
| **Total** | **91** |

# APPENDIX D:

## *Chapter 4: Individual research methods*

### Appendix D.1: LVIA: Review of existing LVIAs for windfarms

For stage B1 of the LVIA review, to aid comparison, schemes were selected to be similar in regards to the following attributes: windfarm size (between 10 and 35 wind turbines); wind turbine size (mostly 110m to tip, although one scheme 93m to tip); location (all within Caithness and north east Sutherland); and period of LVIA production (all produced over a relatively short period between 2002 and 2007). To understand how different professionals assessed and described scale effects, the LVIAs were selected for having been produced by four different landscape architecture consultants.

Table D.1.1: Stage B1- List of existing LVIAs for windfarms reviewed

| *Windfarm* | | *No of wind turbines* | *Date of LVIA assessed*[11] | *Height of wind turbine to blade tip*[12] *(m)* |
|---|---|---|---|---|
| 1 | Strathy North | 35 | 2007 | 110 |
| 2 | Dunbeath | 23 | 2005 | 110 |
| 3 | Baillie | 21 | 2006 | 110 |
| 4 | Dounreay | 10 | 2002 | 93 |
| 5 | Spittal Hill | 30 | 2007 | 110 |

| Table D.1.2: Stage B1 - References for windfarm LVIAs and Environmental Statement reports reviewed |
|---|
| RPS Consultants (2006) *Baillie Wind Farm: Addendum.* Glasgow, RPS Consultants. |
| RPS Consultants (2006) *Baillie Wind Farm: Addendum.* Glasgow, RPS Consultants. |
| RPS Consultants (2007) *Spittal Hill Wind Farm Environmental Statement*. Glasgow, RPS Consultants. |
| Land Use Consultants (2002) *Dounreay Windfarm Environmental Statement: Prepared for CRE Energy, a Scottish Power Company.* Glasgow, Land Use Consultants. |
| Scottish and Southern Energy PLC (2007a) *Strathy North Wind Farm Environmental Statement, Volume 2 – Written Statement*. Perth, Scottish and Southern Energy. |
| Scottish and Southern Energy PLC (2007b) *Strathy North Wind Farm Environmental Statement, Volume 3 – Figures*. Perth, Scottish and Southern Energy. |
| Scottish and Southern Energy PLC (2007c) *Strathy North Wind Farm Environmental Statement, Volume 4 – Appendices*. Perth, Scottish and Southern Energy. |
| West Coast Energy (2005a) *Dunbeath Wind Farm Environmental Statement, Volume 1*. Edinburgh, RDC Scotland and Gruppofalck. |

[11] Previous or subsequent LVIAs were produced for some developments
[12] Height of wind turbine plus blade in its highest vertical position

| |
|---|
| West Coast Energy (2005b) *Dunbeath Wind Farm Environmental Statement, Volume 3 - Figures*. Edinburgh, RDC Scotland and Gruppofalck. |
| West Coast Energy (n.d.1) *Dunbeath Wind Farm Supplementary Information, Volume 1, Part 1*. Flintshire, RDC Scotland and Gruppofalck. |
| West Coast Energy (n.d.2) *Dunbeath Wind Farm Supplementary Information, Figures, Volume2*. Flintshire, RDC Scotland and Gruppofalck. |

| Table D.1.3: Stage B2 - References for windfarm LVIAs and Environmental Statement reports and capacity assessment reviewed |
|---|
| Carol Anderson and Alison Grant Landscape Architects (2011a) *Dumfries and Galloway wind farm landscape capacity study: Main report.* Dumfries and Galloway Council. |
| Carol Anderson and Alison Grant Landscape Architects (2011b) Dumfries and Galloway wind farm landscape capacity study: Appendix report. Dumfries and Galloway Council. |
| Carol Anderson and Alison Grant Landscape Architects (2012a) *Argyll and Bute wind energy capacity study: Main study report.* Argyll and Bute Council. |
| Carol Anderson and Alison Grant Landscape Architects (2012b) *Argyll and Bute wind energy capacity study: Final appendix report*. Argyll and Bute Council. |
| Druim Ba Sustainable Energy (2011a) *Druim Ba Wind Farm Environmental Statement, Volume 3, Figures.* Report submitted with Section 36 Application, March 2011. |
| Druim Ba Sustainable Energy (2011b) *Druim Ba Wind Farm Environmental Statement, Volume 2, Written Statement.* Report submitted with Section 36 Application. |
| Entec (2003) *Dalswinton Windfarm Environmental Statement.* Report produced for Airtricity Developments Scotland Limited to accompany a planning application. |

| Table D.1.4: Stage 1 initial review of existing LVIAs – Criteria for assessment of scale effect | |
|---|---|
| *a* | The type of scale effects described; |
| *b* | The terms used to describe scale effects, including whether these were defined or qualified and the consistency of their application |
| *c* | The type of scale effects omitted from the description of effects. |

| Table D.1.5: Stage 2 detailed review of existing LVIAs – Criteria for assessment of scale effect | |
|---|---|
| **1** | **Landscape and visual resource – sensitivities of baseline to scale** |
| a | Perceived scale of landscape and visual elements, both in terms of relative size and distance, and including whether human scale reference can be made. Existing elements of large scale and/or vertical emphasis, including both built elements (eg masts, pylons or towers) and natural elements (eg hills or cliffs). |
| b | Scale of spaces, edges and points, and landscape pattern, and how these are experienced, such as whether perceived as being relatively large or small, enclosed, open or exposed, or whether there is a sense of refuge within the landscape. |
| c | Perceived difference or separation between different areas of local landscape character and the experience of these, for example viewing hills from adjacent strath floor. |
| d | Simplicity of landform and land cover (affecting prominence and clarity of elements). |
| e | Distribution and experience of receptors, including whether settlements, isolated/clustered residences, roads or paths, and the mode of travel or activity. |

| | |
|---|---|
| f | Landform edges and differences in elevation, for example whether steep/vertical edges or an isolated landform feature. |
| **2** | **Consideration of windfarm design** |
| ***Wind turbine type*** | |
| g | Scale of wind turbines relative to other built or natural elements in the landscape, for example landform or vegetation |
| h | Scale and proportion of wind turbine blades and rotor diameter in relation to wind turbine tower |
| i | Compatibility of wind turbine size with other existing and consented wind turbine groups (which may be part of the same scheme or part of a different scheme) |
| j | Consistency of colour and tone of wind turbine components and colour contrast with the visual backdrop |
| k | Requirement for wind turbine lights |
| ***Numbers/ extent of wind turbines*** | |
| l | Extent of windfarm in different directions, including sense of encirclement, creation of a collective edge, and the collective extent in relation to the wider landscape visible |
| m | Extent of wind turbines in relation to apparent open space(s), edges or distinct landscape feature(s) |
| n | Apparent sub-grouping of wind turbines (as experienced, not necessarily in terms of actual spacing apart) |
| ***Layout of wind turbines*** | |
| o | Layout of wind turbines that provides cues for perceiving the scale of the windfarm, for example a regularity of equally spaced wind turbines indicating distance |
| p | Perceived cohesion of windfarm, affecting whether its scale is judged as a collective group or as a series of individual wind turbines |
| q | Extent and distribution of associated infrastructure, such as access tracks or masts, that may provide scale reference across a site, particularly indicating distance |
| **3** | **Windfarm siting** |
| r | Siting of windfarm in relation to distribution of receptors, including proximity of receptors and whether people will judge scale of windfarm from multiple viewpoints in different landscape character types, viewpoint types and at different distances and orientations. |
| s | Relative elevation of windfarm and receptors, including whether views are from below or reveal only parts of the wind turbines |
| t | Position of windfarm group and individual wind turbines in relation to distinct spaces, edges or foci, including landform slopes or tops |
| u | Position of wind turbines in relation to the skyline and a land or sky backdrop, and whether this varies for different viewpoints and/or the distance between the windfarm and backdrop can be perceived clearly |
| **3** | **Consideration of alternatives, establishment of most appropriate scale of proposal, and mitigation of scale effects as necessary** |
| **4** | **Description of residual scale effects, including distinction between magnitude and significance of scale effects and difference between effects on landscape resource and visual resource** |

## Appendix D.2: Site assessment of the sensitivities to scale and scale effects of existing windfarms

| Table D.2.1: List of windfarms assessed during LVIA method stage C | |
|---|---|
| *Windfarm name and location (ordered alphabetically)* | |
| *1* | *Achairn, Caithness* |
| *2* | *Achany, Caithness* |
| *3* | *Arecleoch, Dumfries and Galloway* |
| *4* | *Artfield Fell, Dumfries and Galloway* |
| *5* | *Balquhindachy, Aberdeenshire* |
| *6* | *Bears Down, Cornwall* |
| *7* | *Buolfruich, Caithness* |
| *8* | *Carland Cross, Cornwall* |
| *9* | *Causeymire, Caithness* |
| *10* | *Cold Northcott, Cornwall* |
| *11* | *Dalswinton, Dumfries and Galloway* |
| *12* | *Delabole, Cornwall* |
| *13* | *Findhorn, Moray* |
| *14* | *Flex Hill, Caithness* |
| *15* | *Four Burrows, Cornwall* |
| *16* | *Goonhilly, Cornwall* |
| *17* | *Hadyard Hill, Ayrshire* |
| *18* | *Hagshaw Hill, Lanarkshire* |
| *19* | *Kentish Flats (offshore), Kent* |
| *20* | *North Rhins, Dumfries and Galloway* |
| *21* | *Skelmanae, Aberdeenshire* |
| *22* | *St Breock, Cornwall* |
| *23* | *St John Wells, Aberdeenshire* |
| *24* | *Tullo, Aberdeenshire* |
| *25* | *Whitelee, Renfrewshire* |

| Table D.2.2: Characteristics for assessment to identify the sensitivities to scale and scale effects of existing/ proposed windfarms* | |
|---|---|
| *No* | *Characteristic* |
| **Key characteristics of the landscape, including:** | |
| 1 | Scale and form of landform features, including juxtaposition and relative scale |
| 2 | Type of landscape pattern or simplicity of land cover |
| 3 | Character of vertical elements in the landscape |
| 4 | Character of skyline visible and how this relates to landform and land cover |
| 5 | Scale and type of spaces created by landscape pattern and landform |
| 6 | Perceived enclosure or openness within the landscape |
| 7 | Character of edges within the landscape, including formed by landform or landscape pattern |
| 8 | Distribution of landscape features, for example clustered, isolated or linear |
| 9 | Distribution and character of settlement and routes through landscape |
| 10 | Landmarks and reference features, including water bodies |
| **Key characteristics of visual resource, including:** | |
| 11 | Type and distribution of visibility within the landscape |
| 12 | Locations of key views within the landscape, including different landscape areas and elevation |
| 13 | Type of key views within landscape, eg framed, open or filtered |
| 14 | Visual composition of the landscape, eg presence of foci, visual pattern and relative visual scale of elements in visual composition |
| 15 | Visual cues for judging scale or distance |
| **The experience of the landscape, including:** | |
| 16 | The location, distribution and sequence of key vantage points within the landscape, including from settlements, roads, paths and visitor attractions |
| 17 | The mode, speed and routes along which people move through the landscape |
| 18 | The elevation of locations from which landscape is experienced |
| 19 | Perceived qualities of tranquillity, sanctuary or refuge |
| 20 | Locations where people go to enjoy the landscape for different activities |
| **Windfarm type, including:** | |
| 21 | Wind turbine characteristics, eg form, proportions, colour and lights |
| 22 | Range of wind turbine sizes within windfarm and relative to other windfarms |
| 23 | Layout and spacing of wind turbines as these influence perception of scale or scale effects |
| 24 | Nature of wind turbine blade rotation and relation to other moving elements in the landscape |
| 25 | Collective relationships between multiple windfarms |
| **Relationship between windfarm and landscape, including:** | |
| 26 | Perception of size and distance of wind turbines in the landscape |
| 27 | Relative scale of wind turbines to other landscape elements or features, including landform characteristics and features |
| 28 | Siting of windfarm in relation to landform slopes and/or edges |
| 29 | Extent of windfarm in relation to key landscape characteristics |
| 30 | Extent of windfarm related to how the landscape is experienced, including from settlements and routes |
| 31 | Extent of windfarm in relation to surrounding open spaces and enclosed spaces |
| 32 | Relationship of windfarm to landscape pattern, including scale and distribution of elements |
| 33 | Relationship between windfarm and other vertical elements |
| 34 | Relationship between windfarm and visual backdrop within the range of view types |
| 35 | Proximity of windfarm to other landscape elements and from where it is typically experienced |
| 36 | Elevation of windfarm in addition to landform features in relation to from where it is viewed in the landscape |
| 37 | Distribution and character of different vantage points of windfarm |

**Not all the characteristics will be relevant/ significant for all cases*

## Appendix D.3: Experiential landscape assessment - Review of existing studies relevant to the research method

<table>
<tr><th colspan="2">Table D.3.1: Studies that informed development of the experiential landscape assessment research method (ordered alphabetically)</th></tr>
<tr><td>Study</td><td>Appleyard, D., Lynch, K. and Myer, J. (1964) The view from the road. Cambridge, Massachusetts, MIT Press.</td></tr>
<tr><td>Relevance to this research</td><td>Assessing the dynamic and sequential experience of the landscape, including analysis of spatial characteristics. Example of the combined use of narrative text and illustrations.</td></tr>
<tr><td colspan="2">Aspects applicable to research method
<ul>
<li>Method for assessing the sequential experience of the landscape and how this can help us to understand better our surroundings: To see how elements are organised; what these symbolise; how people use the landscape; and how it relates to the observer (p2).</li>
<li>Consider how our impression of our landscape is affected by the way in which we move through it, for example different focus, width of view, whether captive audience, opportunity to stop. Also consider 'the elements of attention': Different directions and foci of view; moving objects; orientation; speed of travel; focus; quality of light; and sense of motion (p4, 5, 6).</li>
<li>Consider different experience moving in opposite directions along a route and also how may join or leave a route at different points (p5).</li>
<li>Sense of space changes in relation to the perception of confinement and the dimensions of that confinement, and influenced by form, proportions, character of defining elements or objects in the space, and the position of the observer. Note, not just confinement horizontally, but also vertically (eg rising slope ahead, passing over crest, to see distant horizon) (p12). Consider how perceived scale is different for pedestrian to car driver, including relative scale to surroundings, as well as speed of travel and frame of view (p13).</li>
<li>Importance of person orienting themselves within a composition, with landmarks or foci providing goals and measures of progress. Note value of being able to recognise a scene, knowing how it fits together and how somebody fits in within this (p16).</li>
<li>Development of method that involves recording, analysing and communicating sequences of experience. Key issue stated is to '…select essential elements from the mass of things potentially perceivable'. Highlights limitations of photographs and movies compared with sketches in which you can eliminate unnecessary detail and focus upon that which is most difficult (pp19, 20).</li>
<li>Method developed for experience along road, but nonetheless transferrable criteria (p21):
<ul>
<li>Apparent self-motion and apparent motion of the visual field</li>
<li>Spatial characteristics – presence and position of enclosing objects or surfaces, their solidity and degree of enclosure</li>
<li>General proportions of the space enclosed, scale with respect to the observer, position of the observer</li>
<li>Quality of the light which makes the space apparent, intensity and direction</li>
<li>Relationship of spaces in sequence, jointing and overlapping</li>
<li>Direction of principal views, which draw the eye toward different aspects of the spatial enclosure</li>
</ul></li>
<li>Development of notation system, but with limitations highlighted, such as amount of information provided, greater difficulty of indicating space rather than location or sequence,</li>
</ul></td></tr>
</table>

| Table D.3.1: Studies that informed development of the experiential landscape assessment research method (ordered alphabetically) | |
|---|---|
| fluctuating characteristics such as activity and light (p23).<br>• How to combine narrative, maps, notation, photographs and sketches. The use of drawings to convey a strong feeling of motion and sequence (pp 27, 37, 58). | |
| *Study* | SNH (Scottish Natural Heritage) (1994) Seaboard local landscape study. Project report: Scottish Natural Heritage. |
| *Relevance to this research* | Comparable rural Scottish landscape and assessment of landscape experience at workshop using different media such as artwork, maps and model. Definition of perceived boundary of home and community. |
| ***Aspects applicable to research method***<br>• Participants asked to identify what they believed to be the boundary of where they considered home and community, defining the study area (pp4, 8).<br>• Participants used a variety of media to communicate what they thought was special and distinctive about their landscape, such as maps, collage, paintings, sketches, descriptive terms and a 3D model for which it was judged it was easier to place themselves within the representation of their surroundings.<br>• Breaking down characteristics and qualities into their basic constituents, such as colour or shape, drew out the relative contribution of natural and artificial/ built elements.<br>• Participants chose to identify some characteristics and qualities by type (eg colours and shapes) and some by geographical location (eg smells and sounds).<br>• Workshop was well attended by wide range of people, but its planning, execution and interpretation of findings involved a large number of people and a lot of time and effort for a relatively small study area. | |
| *Study* | The Research Box, LUC and Minter, R. (2009) *Experiencing Landscapes: Capturing the cultural services and experiential qualities of landscape*. Natural England Commissioned Report NECR024. Cheltenham, Natural England. |
| *Relevance to this research* | Example of study of people's experience of the landscape including focus groups and interviews. Provides example of structuring of information and also issues of experiencing landscapes that need to include in assessment criteria. |
| ***Aspects applicable to research method***<br>• Use of focus groups and in-depth interviews with a range of participants.<br>• Structure of information into cultural services, including some particularly relevant, such as 'a sense of place', 'escapism' and 'inspiration' (p4). Also draws out general landscape experiences relevant to features in the landscape and issues such as attitudes to openness.<br>• Describes an approach to assess people's affordances, identifying a portfolio of different types of experience for different purposes (p5). This includes identifying the importance of the everyday landscape as well as special attractions (pp23, 25).<br>• Highlights that the general public finds it difficult to distinguish the different parts of the landscape and tends to recognise it as a '…sum of its component parts' (p19). The importance of combined experiences is emphasised.<br>• The description of findings includes a combination of quotes from participants in their own words together with the authors' analyses that conveys issues clearly. | |

| Table D.3.1: Studies that informed development of the experiential landscape assessment research method (ordered alphabetically) | |
|---|---|
| *Study* | Thwaites, K. and Simkins, I. (2007) *Experiential landscape*. Abingdon, Routledge. |
| *Relevance to this research* | Provides background to contemporary understanding of experiential landscape. Describes method of assessment, including semi-structured interviews, categorisation and coding. |

***Aspects applicable to research method***

- Experiential landscape assessment approach should be people oriented. Based on cognitive mapping, it links human experience with spatial characteristics (pp35, 81, 82).
- Combine input from professionals and the public to produce a more complete understanding of the experiential characteristics of a setting than would occur from either separately (p37).
- Need to provide a vocabulary to help people communicate and understand the experiential landscape (xi).
- Address places people visit every day, often encountered sub-consciously, but nonetheless important (p40).
- Experiences can be categorised in spatial terms at various scales (p115). Recommend: Centre; Direction; Transition; and Area (CDTA). Not separate experiences and not recognised by most people as being so (p50), but distinguishable variations in the continuity of place experience detectable at specific locations (p38).
- Consider scale as being dynamic depending on human activity and perceptions, rather than fixed physical characteristics (pp115-116).
- General approach based on gathering information from individuals, recording and coding this graphically, and then layering this to interpret the experiential characteristics of a setting (pp79, 81).
- There is a structured approach to gathering relevant information, and recording and interpreting the findings which follow the general principles of Grounded Theory. Following this approach, there is development of theory following conceptualisation and categorisation procedures based on identification of comparisons and differences in the data (p38).
- Found the use of standard field record sheets 'unnecessarily rigid' and that, as long as information was recorded following a clear structure, flexibility of note-taking resulted in greater detail being provided on the setting and better highlighting of what was most important (pp85-86).
- Semi-structured interviews are the best way to gather the information if possible (p83).
- For semi-structured interviews, advises that participants be allowed to range as naturally and freely as possible in their responses to questions whilst maintaining some underlying structure to the session. Advise don't try to dissect a person's account of their experience into discrete categories (because this is intrinsically complex and overlapping). Conversely, develop themed conversations so people can describe their experience of the landscape in as natural way as possible (even if this is not the structure applied for assessment on site). Steer participants to think in different ways about locations that stand out for them for various reasons, eg routes they take routinely or avoid, or places where they feel changes occur etc (pp91-92).
- Conduct the interview whilst looking at a big plan, as this helps participants to orientate and/or acts as a prompt to jog memories (p94).

<table>
<tr><td colspan="2">Table D.3.1: Studies that informed development of the experiential landscape assessment research method (ordered alphabetically)</td></tr>
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- The information gathered can be in different forms, eg voice recordings, transcribed text, supplementary notes or diagrams. The raw data then needs to be interpreted to fit in with the established structure (involving coding) (p94).

</td></tr>
<tr><td>Study</td><td>University of Edinburgh (1974) Applecross peninsula study 2. Postgraduate Diploma in Landscape Architecture, Second Year Project, 1973-74. Project report: University of Edinburgh.</td></tr>
<tr><td>Relevance to this research</td><td>Comparable rural Scottish landscape and assessment of landscape experience along routes, including use of a notation system.</td></tr>
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***Aspects applicable to research method***

- A previous study on which this one was built, assessed ‘emotive, perceptual and aesthetic responses’ to the landscape in terms of: colour; texture; skylines; shape; artefacts; scale; views in; views out; framing; light and shade; and reflection. This study built-upon this information with a sequential study of the landscape experience along roads and footpaths (pp5,7).
- The study considered there were three major elements of the landscape experience: the physical structure; natural systems within this; and the perceptual experience related to the first two elements. For these, it assessed the range of components, the frequency of occurrence and points of change, and unique elements (p11).
- When assessing the road experience, it was found that movement was influenced strongly by landform and interconnected journeys were very different from local places or areas (p14).
- A notation system was developed to describe the experience along roads, divided as follows (p15):
    - Road views: continuous view; brief glimpse; expansive view from a point
    - Road space: sense of enclosure; trees on one side; trees on both sides with a glimpse through, overhanging trees; settlement
    - Road motion: sense of curving; sense of hills; and curves
- Understanding the experience of the landscape informed the identification of ‘character zones’ for different development types, influencing guidance for these on the scale and shape of development and special areas that were sensitive (pp18-19).

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<tr><td>Studies</td><td>A Ward Thompson, C. (2010) Landscape quality and quality of life. In: Ward Thompson, C., Aspinall, P. & Bell, S. eds. Innovative approaches to researching landscape and health: Open Space, People Space 2.<br><br>B Ward Thompson, C., Roe, J., Alves, S. (2007) Woods in and around towns (WIAT), evaluation: baseline survey.</td></tr>
<tr><td>Relevance to this research</td><td>Consideration of affordances in landscape preference and the relevance to quality of life. Use of mapping techniques to represent environment-behaviour relationships and the dynamic experience of physical and spatial structure</td></tr>
<tr><td colspan="2">

- Assessment technique offers possibility of linking environment-behaviour relationships with the dynamic experience of the physical and spatial structure of the landscape. Can use mapping symbols that represent visual and spatial qualities as well as affordances, understood by both the public and professionals, so the method is repeatable and can be interpreted for different purposes (A,pp245, 252).
- Need to engage directly with people to understand ‘culturally infused motivations’ behind affordances, to understand what the environment affords different people for different

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| Table D.3.1: Studies that informed development of the experiential landscape assessment research method (ordered alphabetically) |
|---|
| activities (A, pp249, 252).<br>• Need to understand people's attitudes, perceptions and values towards their local environment, as well as how local people are using this and how often (F,p2).<br>• Combination of public questionnaire, environmental audit and spatial analysis. Audit includes rating qualities of neighbourhood, access/signage, woodland quality, facilities, use, maintenance/ management, and security/safety) (B,pp2-4).<br>• Spatial analysis carried out for 'typical path experience'. This is reported using text, map with symbols that indicate dynamic experience, and photographs. The mapping symbols record the nature of views, surrounding vegetation and the spatial characteristics of these (eg density and size), and the sense of enclosure and slope (B,p4-5). |
| |
| *Other useful publications referenced during development of the experiential landscape assessment method* |
| Appleton, J. (1996) *The experience of Landscape.* Revised edn. Chichester, John Wiley & Sons Ltd. |
| Fyfe, F. (2011) *Exmoor landscape perceptions study*. Prepared on behalf of Exmoor national Park Authority and the Exmoor Society [internet], available from http://www.exmoor-nationalpark.gov.uk/__data/assets/pdf_file/0003/136245/Comp-Final-report-Perceptions.pdf [Accessed 23 August 2015]. |
| Kaplan, R. and Kaplan, S. (1989) *The experience of nature: a psychological perspective*. New York, Cambridge University Press. |
| LUC (2011) *The Cairngorms National Park: The view from the road*. Cairngorms National Park Authority. Unpublished. |
| Lynch, K. (1960) *The image of the city*. Cambridge, Massachusetts Institute of Technology Press. |
| Scott, M. (1999) *Local Perceptions of Strathdon: Perceptions by the people in Strathdon of their community and* landscape. Landscape Research and Design Unit, Edinburgh College of Art/ Heriot-Watt University for the Forestry Commission. Unpublished. |
| SNH and The Countryside Agency (2002a) *Landscape Character Assessment: Guidance for England and Scotland*. Redgorton, Scottish Natural Heritage. |
| Ward Thompson, C. and Scott Myers, M. (2004) Community perceptions of local landscapes. In: *Landscape 21*, Vol 1, pp 7-18. |

## Appendix D.4: Structure for experiential landscape assessment of case study areas

| Table D.4.1: Prompt list for site assessment for experiential landscape assessment | |
|---|---|
| *Category* | *Aspect to assess** |
| Distribution and relationship between landscape character, settlements, residences and routes from which the landscape is experienced | • Distribution of foci, stopping places or areas, and sequential routes. Relationship of these to open spaces in-between, including distribution of open space to developed space. |
| | • Density, directions and distances of routes. |
| | • How human-scale references relate to wider landscape, and visible link between these. |
| | • Relative position of features within fore, mid and background of views. |
| | • Variation/ simplicity in landscape character and settlements, residences and routes. |
| | • Distinguishable character, identity and/ or community of area and nature of edges/ transitions. |
| Activity of people within the landscape | • For what the land is used, such as agriculture, forestry, infrastructure, residential, or for community or recreational purposes. |
| | • Range of activities by different people at different times |
| | • Duration and frequency of activities, eg every day, twice a day, weekend/ week day. |
| | • Nature of activity, such as casual/ organised, sought out/ incidental, active/ relaxed, static or sequential activity (eg long distance route, destination or meeting place). |
| | • External influences on activities, eg weather or season. |
| | • Activity to seek specific emotion, eg excitement, fear, escape, safety, or sense of refuge. |
| Visibility, legibility and references within the landscape | • Visibility within an area, to the outside, or in from the outside. Legibility of landscape components/ areas within overall composition, and location of observer within this. |
| | • How visibility and judgement of scale is affected by landform, eg relative elevation, plateaux, convex/ concave slopes. |
| | • Visibility of ground cover (including cues for estimating relative distance and location). |
| | • Effects of vegetation on visibility, eg framed, increased prominence with colour contrast. |
| | • Variable screening at various distances, eg screening of midground so direct comparison of foreground and distant elements without knowing distance in-between. |
| | • Foci and landmarks/ reference points and the distribution and character of these |
| | • Focus on fore, mid or background within views. |
| | • Presence or absence of elements of definite size or extent. |
| | • Vertical, horizontal and/or diagonal emphasis of elements. |
| | • Pattern or organisation of built and natural elements. |

| | |
|---|---|
| Spatial characteristics and the experience of these | • Variation of spaces and distribution or pattern of these, eg varying with elevation. |
| | • Scale of spaces and perception of exposure/ openness or enclosure/ shelter. |
| | • Relative elevation of spaces in relation to extent and edges, eg perception of being 'on top of the world' or hidden with a sense of refuge. Definition of this, for example by contrasting ground cover, pattern or slope. |
| | • Juxtaposition/ sequence of spaces, including whether one accentuates the other, abrupt or gradual changes, different tiers, apparent separation or set-back of one from another, changes of slope or elevation. |
| | • Edges of spaces, including containment/ shielding and visual backdrop, and whether the edge seems impenetrable, to encircle space or create an amphitheatre effect. |
| | • Proportion of land to sky experienced within spaces, such as an expansive sky or predominant screening, eg by slope or vegetation. |
| | • Foci within spaces, including location, concentration or dispersal, and relationship with observer, affecting their sense of orientation and place. |

** There is some repetition/ cross-over of aspects within different categories*

| Table D.4.2: Outline structure for semi-structured interviews for experiential landscape assessment | | |
|---|---|---|
| Question | | Purpose/ notes |
| a | What do you think are the key characteristics and qualities of the landscape? | This question provided a 'warm-up' to the experiential landscape assessment, to get participants thinking and talking about their landscape and establish the landscape and visual baseline. The information received overlaps with the LVIA method. |
| b | Where do people go to experience these characteristics? Additional prompts, if necessary, included for example in the house, in the garden, within the local area, linked to other activities?<br><br>When do people experience these characteristics? Additional prompts, if necessary, included for example on the way to work or on the way to school? | To understand the distribution of the characteristics and qualities and where and when people experienced them. Reference was made to a 1:25,000 or 1:50,000 Ordnance Survey base map (depending on participants' preference) to make it easier to point out locations or routes when this made it easier for either the participants or the researcher. |
| c | Who do you think are the main people that experience these characteristics or qualities and why? Additional prompts, if necessary, included for example dog-walkers, families, residents, visitors? | To understand by whom the landscape characteristics were experienced and for what reason (affordance). |
| d | What do you think are the main changes that have occurred in the landscape and are continuing to occur?<br><br>How do you think that the landscape could change over time for positive effect? | To understand the context in which the landscape has changed and is continuing to change. To understand better how people valued different characteristics and qualities of the landscape, by their indication of what they would like to remain and what could improve their experience of the landscape in the future. |
| e | Looking at the view (if in the field) or a photograph (inside), can you indicate which features you think help you to judge the size or distance of features in the landscape? | To understand which cues people refer to for an indication of scale (whether this improves actual accuracy or not). |
| f | How do you think the existing or proposed windfarm affects the key characteristics or qualities of the landscape?<br><br>How do you think it affects the experience of this and/or the behaviour or activities of people? For case study A, how do you think these effects have changed over time?<br><br>How do you think your experience of the effects of the windfarm would have been different with other sizes and/or numbers of wind turbines? | To understand how the existing or proposed windfarm affects the key characteristics and qualities of the landscape and visual resource and how these are experienced and influence behaviour or activities.<br>To understand how perception of these effects has changed over time with greater familiarity and, in reference to wireline diagrams, how these effects might have been different with alternative-sized wind turbines. |

## Appendix D.5: Public attitude and preference study method: Pilot study for a questionnaire to understand the words people use to describe scale effects

A pilot study was carried out for the public attitude and preference questionnaire to understand the words people use to describe scale effects. Given that the final questionnaire would be sent out to both professionals and members of the public, the pilot included representatives from both groups. The pilot study was carried out with six participants.

Four of the questionnaires were carried out whilst the researcher was present, so that she could observe the time and nature in which the participant completed the questionnaire, for example the sections which took them longer or if they flipped back and forth between different questions and/or between this and the introduction. The other two questionnaires were posted to participants, mimicking the final distribution of the questionnaires.

For each pilot questionnaire exercise, the researcher did not provide any guidance in addition to that included within the paper questionnaire itself but, once the questionnaire had been completed, the researcher asked each participant a number of questions to receive feedback. The questions were as follows:

a Generally, how did you find the questionnaire?

b What did you think about its format?

c How clear did you find the introduction and instructions for completing the questionnaire?

d Did you find the images clear enough in order to select an appropriate descriptive word?

e How easy did you find the selection of words; were there any particularly problematic words, and how easy did you find judging the strength of effect?

f What did you think about the length of time it took to complete the questionnaire?

g Would you have completed this questionnaire if it had been sent to you by somebody you didn't know? Would an incentive help, eg a voucher?

h Is there any other information that would have helped you complete the questionnaire?

i Any other comments?

Some of the feedback received was fairly straightforward, such as support of the introductory text, images or questionnaire length. Nonetheless, Table D.5.1 raises a number of points that needed to be addressed through changes to the questionnaire and/ or are relevant for use of similar questionnaires in the future.

| Table D.5.1: Key points raised in feedback on the pilot questionnaire to understand the words people use to describe scale effects | |
|---|---|
| *No* | *Notes/ feedback* |
| 1 | Some raised the issue of benchmarks for judgements of scale effects and said they flipped back and forth to judge different schemes in relation to each other. Although it was preferred if people judged the scale effects of each scheme independently, as this is how a windfarm would be experienced in reality, there was no way to stop participants from flipping back and forth with a paper questionnaire (this would have been possible if web-based). |
| 2 | One difficulty found by many was that a ‘good’ rating for different terms would be at different ends of the Likert scale depending on the term. For example, a 5 for ‘balanced’ would usually reflect a good scheme, while a 5 for ‘dominating’ would usually reflect a poor scheme. This meant people were sometimes confused which approach to take in the ratings. To address this problem, the columns were re-worded and changed to weak - strong.<br><br>Some suggested it might be clearer if there was a sliding scale of effect with opposites at either end, eg ‘unassuming’ to ‘overbearing’. The trouble with this kind of spectrum was that, at this stage of the research, it was not clear which words people would consider opposites, eg that they considered ‘unassuming’ to be the antithesis of ‘overbearing’. So, while some terms lend themselves to this kind of range, eg obtrusive to unobtrusive, other terms such as dominating do not. |
| 3 | Some remarked on how some terms seemed awkward or uncommon, such as ‘comparable’ and ‘diminutive’, so these were removed. |
| 4 | Some suggested that they would have liked to have added some comments regarding some effects, so a comment box was added to each page. |
| 5 | There were a number of suggestions for alternative words. These were: modest, obtrusive, noticeable, horizontal, neat, contrasting and stained. Only one of these was selected more than once (noticeable) and this was to represent two different scale effect levels. |

## Appendix D.6: Public attitude and preference study method: Demographic question choices for the two questionnaires

| Table D.6.1: Choices for answers to demographic questions in the public attitude and preference study questionnaires | | |
|---|---|---|
| *Aspect* | | *Levels* |
| 1 | Age group | Up to 15 years old |
| | | 16-30 years old |
| | | 31-45 years old |
| | | 46 - 60 years old |
| | | Over 60 years old |
| 2 | Occupation | Occupied mainly with bringing up children/ caring for family |
| | | Student |
| | | Retired |
| | | Tourism |
| | | Arts |
| | | Construction |
| | | Environment |
| | | Education |
| | | Forestry, agriculture or horticulture |
| | | Energy generation |
| | | Administration |
| | | Transport |
| | | Medical |
| | | Other |
| 3 | Location of residence[13] | Rural area from which you can see wind energy development |
| | | Rural area from which no wind energy development can be seen |
| | | Urban area from which you can see wind energy development |
| | | Urban area from which no wind energy development can be seen |
| 4 | Attitudes to wind energy development | Wind turbines can make a useful contribution to renewable energy generation and are a positive way forward |
| | | Wind turbines are inefficient and contribute little to energy generation |
| | | Wind turbines are generally appropriate within Scottish landscapes |
| | | Wind turbines are suited to some Scottish landscapes, depending on their location and design |
| | | Wind turbines are generally inappropriate within Scottish landscapes |
| | | Wind turbines are most appropriate located offshore |
| | | Not sure |
| | | Other |
| 5a | Number of windfarms seen within the previous 5 years in Scotland[14] | 0-5 |
| | | 6-10 |
| | | 11-15 |
| | | More than 15 |

[13] This question was included within the ACBC questionnaire, but not the questionnaire on the words people used to describe scale effects. This was because the latter questionnaire was distributed to different areas on the basis of the variables distinguished by this question.

[14] For the questionnaire on the words people used to describe scale effects, distinction was not made between windfarms seen in or outside Scotland, but this was added for the ACBC questionnaire following feedback on the first questionnaire.

| | | |
|---|---|---|
| 5b | Number of windfarms seen within the previous 5 years outside Scotland[4] | 0-5 |
| | | 6-10 |
| | | 11-15 |
| | | More than 15 |

**Appendix D.7: Public attitude and preference study: Copy of questionnaire on the words people use to describe scale effects** *(separate PDF copy on DVD)*

## Appendix D.8: Public attitude and preference study method: Selection of attributes for the Adaptive Choice-based Conjoint (ACBC) analysis questionnaire

Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire

| | ***Attribute*** | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
|---|---|---|---|
| **Identified first through LVIA** | | | |
| **Wind turbine type** | | | |
| 1 | Human scale reference to wind turbine size | An important aspect of perception. Nonetheless, in the field, this is affected mainly by proximity (being able to make the visual link between the scale reference, which may be oneself, and the wind turbine) and elements of landscape pattern. Indeed, it would not be possible to isolate this attribute from these. | Consider this through **proximity**, **landscape type** and **context of experience**. |
| 2 | Ratio/ proportion of blade length to tower height | Proportion of blades to tower is an important attribute. This attribute, nonetheless, tends to be most significant at a local level. This means that, while it is possible to illustrate scenarios of varying turbine proportion within close-up views, it is not possible to represent this clearly within distant views. | Not included within ACBC, although addressed by **proportion of wind turbines** within non ACBC part of questionnaire. |
| 3 | Wind turbine blades | While wind turbine blade length is a key aspect affecting scale perception, it is not possible to distinguish and illustrate clearly this attribute in relation to an entire wind turbine's scale, particularly at a distance. | Included within **size of wind turbines**. Also addressed partially by **proportion of wind turbines** within non ACBC part of questionnaire. |
| 4 | Typical orientation of wind turbines to key views | It was not possible to isolate this factor within consultation as most respondents would see/ had seen a windfarm from a variety of different directions (in contrast to developments in other areas which are mainly seen from one direction). | Not included. |
| 5 | Turbine lights | Although wind turbine lights can affect the perception of turbine size, this is not an attribute on which it was possible to test effects and public preference due to the lack of examples of these within the case study areas. There is also an inability to illustrate this clearly within the questionnaire. | Not included |
| 6 | Turbine colour and texture | Wind turbines tend to be the same colour and texture in Scotland: off white – light grey and matt. This means it was not possible to explore these factors within consultation. Additionally, it would not be possible to represent this within the black and white drawings for the ACBC questionnaire. | Not included. |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| **Range of wind turbine size** | | | |
| 7 | Turbines of varying size at varying distance to viewer | The importance of relative scale judgements between different schemes was highlighted during consultation on case study A. However, for each of the case study areas, it was difficult to isolate this factor as different schemes tended to be experienced slightly differently or in relation to contrasts of local landscape character. | Not included. |
| 8 | Difference of heights between various sized wind turbines as proportion | As above, while the differences between wind turbine sizes proportionately are important, there was not sufficiently clear variation to be able to isolate this factor for the case study areas. Nonetheless, knowledge regarding the distinction of windfarm scale influenced the range of levels selected for wind turbine size. | Influenced selection of levels for **wind turbine size**. |
| **Pattern and extent of windfarm(s)** | | | |
| 9 | Extent of windfarm and features that extend through windfarm site | Although this is an important factor highlighted through consultation on the case study windfarms, it tends to be only recognised from viewpoints close to the development and/or at higher elevation than the development which provide an 'aerial' view of the site. Thus its influence cannot be tested against all the other attributes. | Not included |
| 10 | Horizontal extent of windfarm seen around viewer | This is an attribute that was raised frequently during consultation as affecting scale effect and, specifically, the sense of being 'surrounded' or 'overwhelmed' by windfarms, with no visual 'respite'. It relates to the proximity of windfarms, as well as their size and cumulative effects. Within the questionnaire format, it was not possible to represent more than one cone of vision. | Attribute included within **windfarm size** and **proximity**. Also addressed by **distribution of windfarms** within non ACBC part of questionnaire. |
| 11 | Layout and turbine spacing affecting perception of windfarm scale | While there is not a direct relationship between wind turbine layout and spacing and scale effect, they may affect scale effect in terms of whether the windfarm appears as an isolated individual, small cluster or larger, less (seemingly) ordered development. This is taken into account through the attributes of windfarm size . | Attribute included within **windfarm size** |
| 12 | Extent of wind turbines in relation to extent/ proportion of open space | This is an attribute quoted frequently during consultation as affecting scale effect and, specifically the sense of being surrounded and imposition on people and place. The thresholds for different effects depend upon the character of the landscape and how it is experienced. | Attribute included within **windfarm size** as well as relating to **proximity**. Also addressed by **distribution of windfarms** and **extent of windfarms relative to open space** within non ACBC part |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| | | | of questionnaire. |
| **Landscape pattern and its effect in perceiving distance** | | | |
| 13 | Elements of landscape pattern, and nature and extent of pattern | Although elements of landscape pattern provide cues for perception of distance, it is difficult to isolate this factor from judgements influenced by perceived compatibility with different land uses. | Attribute included within **landscape type** |
| 14 | Distribution of elements of landscape pattern | Similar to 13 above, it is difficult to isolate this factor from judgements influenced by landscape character and a perception of an overbearing scale effect influenced by perceived proximity. | Attribute included within **landscape type** and **proximity** |
| 15 | Simplicity of landscape pattern and simplicity of texture of ground cover | Similar to 13 and 14 above, although this is a very important attribute for affecting the perception of distance, it is difficult to isolate from judgements regarding landscape character. | Attribute included within **landscape type**. |
| 16 | Clarity of wind turbine form in relation to landscape pattern and visual backdrop | While clarity of form of a wind turbine affects the ability to estimate its size, it was not possible to isolate this factor within consultation as most respondents would see/ had seen the windfarm against a variety of backdrops (in contrast to developments in other areas which are mainly seen from one). Additionally it would not be easy to represent the experience of clarity within the format of the ACBC questionnaire. | Not included |
| **Relationship between windfarms and other vertical features** | | | |
| 17 | Relationship between windfarm and other vertical features | Although reference to other vertical features within a landscape clearly aids scale estimation, it is difficult to isolate this factor from judgements regarding landscape type. It should be noted that the nature of the case study areas also meant that certain types of vertical features have not been considered, for example industrial features, because the case study areas are rural in character. | Attribute included within **landscape type** including influencing distinction of levels. |
| 18 | Vertical features as key characteristics of landscape character and visual composition | As above, it is difficult to isolate this factor from judgements regarding landscape type. | Attribute included within **landscape type**, including influencing distinction of levels. |
| 19 | Perceived overbearing effect influenced by size and distance of wind | This is an attribute that was quoted frequently during consultation as affecting scale effect, although the thresholds for different effects depend upon the character of the landscape and how this is experienced. | Attribute included within **proximity** and **size of wind turbines**, as well as |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| | turbines | | **landscape type**. |
| 20 | Perceived overbearing effect influenced by landform | This is an important issue. It is difficult to isolate this factor as most respondents see/ had seen a windfarm from a variety of different directions and elevations in relation to the landform and there is a strong link to landscape character. Nonetheless it relates to proximity and viewer elevation and position relative to windfarm. | Attribute included within **landscape type,** including influencing distinction of levels. Also addressed by **viewer elevation and position relative to windfarm** within non ACBC part of questionnaire. |
| 21 | Scale of spaces created by other vertical features | The scale of spaces and the resulting sense of enclosure is an attribute that was quoted frequently within consultation as strongly affecting scale effect. However, similar to 13, 14 and 17 above, it is difficult to isolate this factor from judgements regarding landscape type. | Attribute included within **landscape type** including influencing distinction of levels. |
| 22 | Character of other vertical elements | As per 17 and 18 above, it is difficult to isolate this factor from judgements regarding landscape type. | Attribute included within **landscape type,** including influencing distinction of levels. |
| **Shape and scale of the landform** | | | |
| 23 | Landform characteristics/ feature of relevant scale to windfarm | Landform scale is an important and prominent attribute affecting the scale effect of wind turbines. It is however difficult to isolate from landscape type as it has a strong influence on this. | Attribute included within **landscape type.** |
| 24 | Vertical emphasis of landform | This is an important attribute in relation to perception of the vertical dimension of a windfarm. It is difficult, however, to isolate from general landform scale (23) above. | Attribute included within **landscape type** |
| 25 | Distinction of landform feature(s) | The distinction of a landform feature affects perception of both 22 and 24 described above. Nonetheless, as such, it is difficult to isolate from these and also from landscape type. | Attribute included within **landscape type** |
| 26 | Proportion of windfarm scale to landform scale | Although this is an important attribute affecting scale effect, it is difficult to isolate from that of landscape type, as well as windfarm size. | Attribute included within **landscape type** and **windfarm size** |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| 27 | Vertical emphasis of edges | This is an important attribute and one that was highlighted for case studies A, B and C. Nonetheless, it is difficult to isolate from landscape type, as the perceived relationship of a windfarm to an edge and the contribution of the layout of wind turbines in forming an edge themselves varies/ will vary from different vantage points. | Attribute included within **landscape type**. |
| 28 | Character of skyline in relation to landform | This is an important attribute and one that was highlighted for all the case studies. Nonetheless, it is difficult to isolate from landscape type, particularly with regards to the height and simplicity of the skyline and affected by vegetation, and it is strongly influenced by the location of vantage points. | Attribute included within **landscape type**. |
| 29 | Distance to skyline | As for attributes 20 and 28 above, this is an important aspect, and was highlighted for all the case studies, particularly where greater visibility occurred with greater distance. However, it is difficult to isolate this factor as most respondents see/ had seen a windfarm from a variety of different vantage points and there is a strong link to landscape type and proximity. | Attribute included within **landscape type** and **proximity.** |
| 30 | Range, character and scale of landform features that form backdrop to views | As for attribute 28 above, this is an important aspect, and was highlighted for all the case studies with regards to the high hill backdrop to some views. However, it is difficult to isolate this factor as most respondents see/ had seen a windfarm from a variety of different vantage points and there is a strong link to landscape type and proximity. | Attribute included within **landscape type** and **proximity**. |
| 31 | Windfarm siting upon landform slopes | This is an important attribute and was raised with respect to case study B. However, the prominence of this factor varies with landscape pattern and it is also difficult to isolate from the general relationship of the windfarm to the landform. | Attribute included within **landscape type**. |
| 32 | Scale of isolated landform features | The case study areas did not include isolated landform features; thus it was not possible to distinguish this attribute. | Not included |
| 33 | Relationship of collective windfarm group to landform features | The case study areas considered only individual windfarms/ windfarm proposals. However this attribute was assessed in part with respect to the overall scale of a collective windfarm group. | Attribute included within **landscape type** and **windfarm size**. |
| 34 | Range of wind turbine height and extent of multiple windfarms in relation to landform | The case study areas did not include windfarms that varied in wind turbine height or multiple windfarms and thus it was not possible to distinguish this attribute. | Not included |
| **Number and rotation of wind turbine blades** | | | |
| 35 | Number of blades | The case study areas did not include windfarms of varying wind turbine blade number and thus it was not possible to distinguish this attribute. | Not included |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| 36 | Blade rotation speed | The case study areas did not include windfarms of varying wind turbine blade rotation and thus it was not possible to distinguish this attribute. | Not included |
| **Elevation of visibility** | | | |
| 37 | Relative elevation of windfarm and key viewers | This is an important attribute and was highlighted for both case studies A and B. Nonetheless, it is difficult to isolate this factor as most respondents see/ had seen a windfarm from a variety of different vantage points and there is a strong link to landform, size of wind turbines and how a landscape is experienced. | Attribute included within **landscape type, size of wind turbines** and **context of experience.** Also addressed by **viewer elevation and position relative to windfarm** within non ACBC part of questionnaire. |
| 38 | Distance of key viewers and angle of view | Similar to 20 and 29 above, it is difficult to isolate this attribute as most respondents see/ had seen a windfarm from a variety of different vantage points and there is a strong link to landscape type, how a landscape is experienced and proximity. | Attribute included within **context of experience** and **proximity**. Also addressed by **viewer elevation and position relative to windfarm** within non ACBC part of questionnaire. |
| 39 | Relative elevation of windfarm to surrounding landform | Similar to 30 and 37 above, this is an important attribute and was highlighted for all case studies. However, it is difficult to isolate this factor as most respondents see/ had seen a windfarm from a variety of different vantage points and there is a strong link to landscape type and how a landscape is experienced. | Attribute included within **landscape type** and **context of experience.** Also addressed by **viewer elevation and position relative to windfarm** within non ACBC analysis part of questionnaire. |
| **Distance, access and vantage points** | | | |
| 40 | Distance of windfarm from viewer | This is an attribute quoted frequently during consultation as affecting scale effect and, particularly, the perception of an overbearing scale effect. The thresholds for different effects depend upon the character of the landscape and how this is experienced. | Attribute included within **proximity** as well as **landscape type**. |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| 41 | Distribution of vantage points within area of windfarm, eg at varying distance and orientation | This is an important attribute and relates to 37 and 40 above. However it is difficult to isolate this factor as most respondents see/ had seen a windfarm from a variety of different vantage points and there is a strong link to landscape type and the context of experience. In addition, it is difficult to describe/ illustrate clearly the distinction of this attribute within the questionnaire format. | Attribute included within **context of experience** and **landscape type** |
| 42 | Use of access routes and vantage points within area | This is an important attribute and relates to 37, 40 and 41 above. However, like these, it is difficult to isolate this factor as most respondents see/ had seen a windfarm from a variety of different vantage points and there is a strong link to landscape type and the context of experience. In addition, it is difficult to describe/ illustrate clearly the distinction of this attribute within the questionnaire format. | Attribute included within **context of experience** and influenced by **landscape type**. |
| 43 | Accessibility to human scale references for windfarm | This attribute was raised for case study B, due to the high number of human scale references that would have been accessible at close proximity to the wind turbines (including from the Great Glen Way). However, for case studies A and C, there tends to be visual separation of direct human scale references (eg by intervening forest plantation). On account of this inconsistency, it is difficult to isolate this attribute. | Not included. |
| 44 | Approaches to windfarm | This attribute was raised for case study A with respect of movement along the main road north-south through the valley following the River Nith, and the various reference points. However the attribute was not distinguished for case studies B and C, as the approaches to the areas are from various direction, elevation and road type. Thus it is not possible to isolate this attribute fully, although it can be represented through the levels for context of experience. | Attribute influenced selection of levels for **context of experience**. |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute/ composite attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| Identified through experiential landscape assessment | | | |
| **Distribution and relationship between landscape character, settlements, residences and routes from which the landscape is experienced** | | | |
| 45 | Experience of the landscape from different directions, different human scale references and in relation to different landscape character types | This experience is very important and was raised for case studies A, B and C. It is, however, difficult to distinguish without presenting a composite sequence which is fairly complex and location specific. Nonetheless, the scenario of juxtaposed settlement and hills can be represented within a level of landscape type. | Included in part within **context of experience** and **landscape type.** |
| 46 | Strong links between adjacent landscape character types, with views passing between these. | This combination affects how the landscape is experienced, and results in reference being made between a windfarm and different landscape character types and features. It is, however, difficult to distinguish without presenting a composite sequence of experience which is fairly complex and location specific. The most typical scenario of settlement with adjacent hills can be represented within a level of landscape type. | Included in part within **context of experience** and **landscape type.** |
| 47 | Juxtaposition of wind turbines with other elements of land use and habitat | This attribute relates to 13, 15, 17, 19 and 46 above, particularly with regards to seeing the wind turbines directly contrasting to adjacent landscape features without a buffer of open space in-between. This attribute relates to proximity and landscape type. | Included within **proximity** and **landscape type**. |
| 48 | Variation of local landscape character | This is an important attribute raised for all the case studies, specifically with regards to people choosing to experience different landscape types for different purposes at different times and in different ways. This means windfarms will affect various landscape character types differently, but also affect collectively/ cumulatively the experience of the whole area. | Included within the attributes **context of experience** and **landscape type**. |
| 49 | Varying presence and pattern of trees, woodland and conifer plantations within landscape. | This is an important attribute raised for all the case studies, particularly in relation to varying fore, midground and distant framing of views and a hill backcloth. Trees and woodland not only contribute to landscape character, but also act as a scale reference, as per 1, 13, 15, 17, 18, 21, 22, 28, 47, 80, 81, 83. It is therefore inappropriate to consider this attribute in isolation and, alternatively, consider it as part of other attributes. | Included within the attributes of **context of experience** and **landscape type**. |
| 50 | Historic pattern and grading of human elements from more dense and larger in scale within low-lying areas, to more sparse and smaller in scale upon elevated areas. | This is an important attribute of all the case studies and is particularly relevant where wind turbines are located upon elevated hill ground above adjacent and low-lying straths, glens or coastal plains, and thus contrast to the typical distribution of different-scaled elements. It is difficult to isolate this attribute as it relates to landscape pattern and character, as well as the landform and how a landscape is experienced. | Included within the attributes of **context of experience** and **landscape type**. |
| 51 | A mixed composition of landscape | This is an important attribute that reflects the distinct combination of different landscape types and | Reflected within the |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute/ composite attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| | types contained within a basin, linked to a specific river and encircled by hills | how they are experienced. This attribute cannot be isolated as it relates strongly to a combination of characteristics and is influenced by different experience of the landscape. However it can be represented in part by the levels of other attributes. | levels of **context of experience and landscape type**. |
| 52 | Past human influence evident throughout the landscape, with a number of archaeological and historical features | This attribute reflects the distinct history of the areas in relation to their physical conditions. While there are direct scale effects with historic features and related to the setting of these, these are site specific depending on the character of the historic feature. | Not included |
| 53 | A number of existing windfarms visible from the larger hills, plateaux and moorland interior and when travelling through the wider area | This is an important attribute quoted frequently during consultation for case study A, specifically the cumulative effect of numerous windfarms affecting the perceived scale of the backcloth hills and resulting in people seeming 'surrounded' or 'overwhelmed' by windfarms. In addition, reference was made to the cumulative effects of windfarms within different landscape character types and of different size and extent. While effects relate to the proximity and size of windfarms as well as the size of wind turbines, it is difficult to represent sequential experiences and/ or several windfarms within the ACBC format. | Addressed by **distribution of windfarms** and **extent of windfarms relative to open space** within non ACBC analysis part of questionnaire. |
| 54 | Mixed composition of landscape combined within distinct basin, experienced at different elevations - typically approached from its elevated edges, giving 'aerial' view of composition before descend towards centre | Similar to 51 above, this attribute reflects the combination of different landscape types and how this relates to the landform and thus distinct identification of places. It is difficult to isolate this attribute due to it being strongly influenced by different experiences of the landscape, although it can be represented in part within the levels of attributes. | Represented in part within **context of experience and landscape type**. Also addressed by **viewer elevation and position relative to windfarm** within non ACBC analysis part of questionnaire. |
| 55 | Interior hills divide settlements, emphasising their distinctiveness and providing a buffer between them | This is an important attribute, mentioned during consultation for all the case study areas, related strongly to sense of place. It cannot be isolated as it relates strongly to a combination of characteristics. Nonetheless, it can be represented partially within the levels of the context of experience and landscape type attributes. | Reflected within the levels of **context of experience and landscape type**. |
| 56 | Access routes (for example roads, rail or across the sea or lochs) encircle the area, providing alternative views of the | This attribute was raised as particularly strong for case study C, and strong in parts for the other case studies. It provides context and informs scale perception of the area as a whole in comparison with its wider surroundings. It is difficult to isolate as it combines aspects of experience, landscape type | Reflected in part within the levels of the **context** |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute/ composite attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| | area from outwith | and accessibility. Nonetheless, it can be reflected in part in the levels for the context of experience. | **of experience**. |
| 57 | Around the outside edge of interior hills, views tend to be directed outwards over adjacent lowland or water | This attribute was raised as important for all the case study areas. It is influenced by aspects of landform shape and elevation, juxtaposition of landscape types, and openness and the experience of prospect. As such, it reflects a combination of characteristics and the experience of these. Nonetheless, it can be reflected in the levels for context of experience and landscape type. | Reflected within the levels of **context of experience and landscape type**. |
| **Activity of people within the landscape** | | | |
| 58 | Dispersal of buildings and routes through the landscape means it is experienced everyday by many. | This attribute was raised as very important for both case studies A and B. It relates to how the landscape is experienced. It is difficult to isolate as an attribute as it is a composite experience and is location specific. Nonetheless, it can contribute to the scenarios of experiences included as attribute levels | Reflected within levels for **context of experience** and **landscape type.** |
| 59 | Woodland and forest areas are used for recreation, valued in many places for their shelter and sense of tranquillity. | This is an attribute raised for all case studies, both in terms of where people tend to go for recreation and the different facilities provided, as well as the particular qualities of woodlands. As the key issue is the experience of these places, it is considered as part of the context of experience and landscape type. | Included within the **context of experience** and **landscape type**. |
| 60 | Upland character of plateau emphasised by steep ascent/ descent of roads upon side slopes, contributing to a sense of being ‘on top of the world’ | This quality was highlighted for both case studies A and B and reflects the experience of the landscape and the perceived importance of the hills. As it is experiential, it is difficult to isolate without presenting a composite sequence of experience which is fairly complex and location specific. However it can be represented through the levels of context of experience. | Included within **context of experience** and **landscape type.** |
| 61 | Most people live, work and travel through the glen floor, lower slopes or around the coasts and thus experience the landscape mainly from these areas on an everyday basis | Related to 45 and 58 above, this attribute was highlighted for all the case studies and reflects the typical experience of the landscape on an everyday basis. It means it is closely related to landscape type and the context of experience and thus can be represented by the levels for these attributes. | Included within **context of experience and landscape type**. |
| 62 | Local recreation tends to be fairly low key, mainly along local routes, although also targeting some local landscape features. In addition, both local people and visitors enjoy some more active | These composite attributes are very important, reflecting how people tend to experience the landscape. It highlights the importance of not only where people go, but also the type of activity in which they are involved which, in turn, influences their requirements and expectations for particular landscape qualities. Given these factors, it is hard to isolate the attribute, but it can be represented | Included within the levels for **context of experience and landscape type**. |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute/ composite attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| | and formal recreation provision, for example long distance routes or mountain bike trails. | by the levels for attributes. | |
| 63 | Some people visit and enjoy the landscape for attractions that are not landscape-driven, although the landscape is enjoyed as part of the experience, for example wildlife-watching or visiting historic features. | This attribute reflects the distinct wildlife and history of the landscape in relation to its physical conditions and was raised as being particularly important within case study C. While this influences the places and contexts in which scale effects would be experienced, these are site specific depending on the type of feature being visited. | Not included |
| 64 | Interior hills and moorlands tend to be visited rarely where good paths do not exist. This means those that visit these areas are able to enjoy strong qualities of solitude and sanctuary. | Although limited access within the hills and moorland means these areas are visited by few and/or infrequently, qualities of solitude and sanctuary result in high sensitivity to windfarms, including scale effects. It is not possible to isolate this attribute as it combines access with landscape type and experience. Nonetheless, it can be incorporated within the attribute levels. | Included within the levels for **context of experience and landscape type**. |
| 65 | 'Scene setting' vantage points from which the overall composition of the surrounding area is revealed, such as high points or promontories, tend to be popular and valued by local people and visitors. | This attribute was highlighted for all the case studies and reflects the value of vantage points in relation to visibility, landform and landscape character. As it is place specific and relates to access, it is difficult to isolate as an attribute. Nonetheless it can be represented through the levels of the context of experience attributes. | Included as level for **context of experience.** |
| 66 | Winding roads through the landscape may contribute to a perception that the landscape is more extensive than its actual dimensions and also provide strongly contrasting views and spatial experiences with changing orientation. | This experience influences perception of distance and thus may also influence the scale effects of a windfarm in terms of its perceived extent or proximity. It also results in a range of different views of a windfarm whilst moving through the landscape. It is nonetheless difficult to isolate without presenting a composite sequence of experiences. Thus it can only be represented in part by the context of experience attribute. | Represented in part by **context of experience**. |
| **Visibility, legibility and references within the landscape** | | | |
| 67 | Woodland and plantation blocks often mask underlying landscape elements | This is an attribute raised for all the case studies, particularly in terms of woodland masking the underlying landscape elements so there is an absence of obvious distance cues. This relates to 1, 13, | Included within the attribute of **landscape** |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute/ composite attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| | and landform. | 15 and 47 above. | **type**. |
| 68 | A hill backcloth forms a landscape feature in some locations and is difficult to scale due to its simplicity of land cover | This attribute was raised for all the case studies, although the land cover varies between these: comprising mainly moorland for case study B and a mix of moorland and forest plantation for case studies A and C. For all the areas, a key issue is that the hills seem higher in relation to the adjacent lowland/ settled areas than warranted by their actual dimensions, and that this quality could be diminished by the introduction of wind turbines. | Included within **landscape type level** and relevant to **size of wind turbines** and **windfarm size** |
| 69 | An upland plateau that seems more extensive than it is due to a lack of distance cues, and difficulty of seeing its outer edges from the centre or across the area from one edge to the other | Similar to 13, 14, 15, 23, 26 and 68 above, this is an important attribute. Nonetheless, it is difficult to isolate as it relates to how the landscape is experienced and there is a strong link to landscape pattern. | Attribute included within level for **landscape type** and **context of experience**. |
| 70 | From the base/ top of the hills, the areas above/ below are screened or influenced by visual foreshortening. In contrast, clearer views may be gained where the landform can be seen 'in profile' from a further distance away (where there is an open 'set-back') or from part way up/down the landform | This attribute reflects the juxtaposition of hill and open areas and how these tend to be experienced, related to 37, 38, 60, 68 and 85. This means it is often difficult to perceive the scale of a windfarm from above or below and at close proximity. Wind turbines that are only seen partially can create a confusing image. It is difficult to isolate this attribute due to it being strongly influenced by landform, wind turbine scale and different experience of the landscape, although it can be represented within the levels of other attributes. | Included within **context of experience** and influenced by **size of wind turbines** and **proximity**. Also addressed by **viewer elevation and position relative to windfarm** within non ACBC analysis part of questionnaire. |
| 71 | Reference features and places are important to indicate orientation and location, including sequential progression along a glen or around a coast. | This attribute was raised as very important for case studies A and C. It relates to site specific features and how the land/ seascape is experienced which is difficult to distinguish without presenting a composite sequence of experience that is location specific. | Not included |
| 72 | Backcloth hills collectively form a ridge with overall horizontal emphasis and no particular top appearing of greater | This attribute is very important to the distinction of the backcloth hills as an edge with a horizontal emphasis, and the effects of a windfarm in terms of introducing contrasting vertical focal elements and the changing effects of this with distance and wind turbine size. It relates strongly to the | Included within the levels of **landscape type** and influenced by **size of** |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute/ composite attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| | focus than others | distinction of the landform and contrasts of landscape pattern. | **wind turbines, windfarm size** and **proximity**. |
| 73 | Simple patterned and dark coloured vegetation upon the slopes of the backcloth hills can make these slopes visually 'recede' in relation to the varied pattern and colours within the glen floor or around the coast, and also highlight the skyline as a key feature. | The importance of the skyline as a prominent landscape feature was raised by many people during consultation for case study A. Its prominence relates to the landform and landcover as well as how this feature is experienced. The degree by which the hills seem to recede in relation to adjacent landscapes would be difficult to convey within the format of an ACBC questionnaire. This means that it is difficult to isolate as an attribute. | Reflected within the levels of **landscape type** and influenced by **context of experience.** Also addressed by **viewer elevation and position relative to windfarm** within non ACBC analysis part of questionnaire. |
| 74 | Elevated views offer distant views of the landscape, including landmarks and to other landscape character types, as well as revealing the landscape pattern below. Distant hill ranges are seen as a series of receding tiers of hill ridges. | This attribute was highlighted for all the case studies and reflects the experience of the landscape in combination with landform and landscape character. As it is experiential and some aspects are place-specific, it is difficult to isolate. Nonetheless it can be represented in part through the levels of context of experience and landscape type. | Included within **context of experience** and **landscape type**. Also addressed by **viewer elevation and position relative to windfarm** within non ACBC analysis part of questionnaire. |
| 75 | Isolated hills or islands surrounded by contrasting lowland or sea create landmarks that can be used as scale/ distance references. | This attribute was raised as important for case study A and C, particularly the latter. They are important as vertical scale and distance cues. Nonetheless the features are location specific and vary in scale and distribution as well as prominence, depending on the juxtaposition of landscape character types and how these are experienced. | Not included |
| 76 | Hills contribute to the vertical dimension of a landscape composition, even if the hills are unremarkable in character, aiding perception of scale and distance. | This attribute was highlighted as important within all three of the case studies (its importance often emphasised when not being able to be seen during poor weather conditions). There are many variations of hills and their relationship to their surroundings that could not be represented fully, but they were represented by a level of landscape character type. | Included within level of **landscape type.** |
| 77 | Numerous landform horizons (for example formed by hills, peninsulas and islands) may create distinct tiers | This attribute was highlighted as particularly important in case study C, particularly as experienced from high points and when looking down lochs. The tiers indicate differences of distance as well as spatial separation. It is not possible to isolate the attribute as it reflects a composite relating to | Reflected partly by levels for **context of experience** |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute/ composite attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| | that mark differences of distance such as between the fore, mid and background, although it is not always clear if these are linked. | landscape type and the context of experience, whilst the effects of a windfarm would be influenced strongly by proximity and how its specific location related to the different tiers. | **and proximity**. |
| 78 | A landscape with horizontal emphasis (as influenced by land or water) amplifies a sense of openness and the qualities of 'wide skies'. Views tend to pass back and forth across the horizons with no specific focus. | This attribute was raised as being important within all three case studies, occurring within extensive areas of plateau and moorland as well as next to water. It relates strongly to landform, although it is also influenced by land cover at a local level. The horizontal emphasis and openness are highly sensitive to the introduction of contrasting vertical focal elements, although the effects of a windfarm would also be influenced by wind turbine size, numbers and proximity. | Reflected in **landscape type** and **context of experience**. |
| 79 | The legibility of the landscape and its scale may vary between light and seasonal conditions, related to colour and texture contrasts, for example dark rock contrasting to snow cover to highlight vertical cliffs. | The influence of seasonal change on legibility of scale within the landscape is important as it may mean scale cues and thus scale effects vary. It was raised as particularly important within case study C due to the exposure of rock faces within the stepped landform whose prominence varied in different season and light conditions. Nonetheless, there are many different types of landscape ground cover and thus all the different variables of light and seasonal change cannot be considered by this study. | Not included |
| **Spatial characteristics and the experience of these** | | | |
| 80 | Small scale human elements within the landscape that contrast to larger scale landform or water | This attribute relates to 1, 17 and 43 above. A key issue is the juxtaposition of small scale built elements that are perceived to be of 'human scale'. There are a number of different ways in which these characteristics contrast, but the combination is reflected in part by the landscape type attribute. | Included in part by **landscape type** and influenced by **size of wind turbines, proximity** and **context of experience**. |
| 81 | A contrast of scale, elevation and enclosure in the landscape. | This attribute is very important and was raised for all the case studies. It is, however, difficult to isolate landscape scale, enclosure/ exposure and altitude from landscape character. It is thus most effective to represent this within the levels for landscape type and context of experience. | Attribute represented by **context of experience and landscape type.** |
| 82 | Sequential experience of areas of contrasting scale | Variation in landscape scale and the experience of this is sensitive to a windfarm having different effects from different parts of the landscape and diminishing the distinction between these. It is, however, difficult to isolate this as an attribute without presenting a composite sequence of | Included in part within combinations of **context of experience**, **proximity** and **landscape type.** |

| Table D.8.1: Summary of individual and composite attributes identified by the LVIA and experiential landscape assessment methods that informed selection of attributes for the ACBC analysis questionnaire | | | |
|---|---|---|---|
| ***Attribute/ composite attribute*** | | ***Factors affecting selection as attribute for Conjoint Analysis**** | ***Attribute inclusion**** |
| | | experiences. Thus it can only be represented in part by landscape type and the context of experience | |
| 83 | Small scale, intimate spaces | These areas were highlighted through consultation as being valued within parts of all the case study areas. They are very sensitive to the location of windfarms due to the contrast of scales. Small scale spaces occur in many different locations and landscape character types. Nonetheless, they are represented in part by levels of landscape type and context of experience. | Represented by levels of **landscape type** and **context of experience**. |
| 84 | Hill/ plateau slopes create a distinct edge that encloses or defines an adjacent lowland area, glen, loch or firth, sometimes creating an amphitheatre effect | This attribute reflects the juxtaposition of hills and strongly contrasting lowland areas/ water. It is a particularly important attribute raised for all the case studies that means that the areas are sensitive to any perceived 'breach' and thus perceived imposition by wind turbines on the seemingly impenetrable, shielding edge. It is a composite attribute and thus cannot be isolated, but reflects landscape type and context of experience. | Included within **landscape type** and **context of experience.** |
| 85 | As one approaches a backcloth slope, there is an increasing sense of enclosure and overbearing effect | This attribute reflects how the landscape is experienced, moving through the landscape and gaining different perspectives of the landform relative to proximity. It is sensitive to the location of wind turbines due to their combined height with visible hill elevation and the resulting sense of imposition. In this way, it is difficult to isolate this attribute, although it can be reflected in different levels of other attributes. | Included within the levels of **landscape type** in relation to **context of experience** and influenced by **size of wind turbines** and **proximity**. Also addressed by **viewer elevation and position relative to windfarm** within non ACBC analysis part of questionnaire. |
| 86 | A combination of vertical landform edges and horizontal shelves can create spaces which seem hidden from the surrounding landscape and are valued by people for their partial enclosure and strong qualities of perceived solitude and sanctuary | This attribute was raised as particularly important in case studies B and C where the undulating or stepped nature of the landform creates 'hidden' spaces. Given their specific qualities of solitude or sanctuary, these are highly sensitive to the effects of seeing a windfarm, including the potential disturbance of rotating blades. Nonetheless, these experiential qualities are difficult to convey within the format of ACBC; thus they can only be represented loosely through the depiction of other private spaces as a context of experience. | The qualities of this attribute are represented loosely through levels of the **context of experience.** |

* Blue text = attribute not included within ACBC
* Purple text = Attribute included within non choice-based part of ACBC questionnaire

## Appendix D.9: Development of the ACBC questionnaire

This appendix provides information on the development of the ACBC questionnaire to supplement the general description included within section 4.3 of chapter 4. It is structured as follows:

i Setting up the structure and format of the questionnaire
ii Inclusion of images within the questionnaire
iii Pilot studies

### *D.9.1 Setting up the structure and format of the questionnaire*

After selection of the attributes to be included in the questionnaire (described within the main thesis chapter 4, following analysis summarised in Table D.8.1 of Appendix D.8), one of the first tasks using Sawtooth software was to set-up the main structure and settings of the ACBC questionnaire (input within the 'design' window). This allowed definition of the number of screening tasks, 'unacceptables', 'must haves', and choice-based tasks (which Sawtooth refer to as the 'choice tournament'). The numbers for these needed to relate to the number of attributes brought into the ACBC and, for the most part, the software default amounts were applied. Nonetheless, there were some that needed to be adjusted from the standard recommendations which Sawtooth state are just 'approximate guidelines' (Sawtooth Software, 2013a, p451), as shown below in Table D.9.1:

Table D.9.1: Design settings for ACBC questionnaire

| Design aspects | Sawtooth general recommendation (based on 5 attributes) | Selection for this research (based on 5 attributes) |
|---|---|---|
| Number of screening tasks | 6 | 6 |
| No of concepts per screening task | 4 | 3 |
| Minimum attributes to vary from BYO selections | 1 | 1 |
| Maximum attributes to vary from BYO selections | 2 | 2 |
| BYO-product Modification strategy | Mixed approach | Mixed approach |
| Number of 'unacceptables' | 3 | 3 |
| Number of 'must haves' | 2 | 2 |
| Maximum number of product concepts brought into choice tournament | 14 | 12 |
| Number of concepts per choice task | 3 | 2 |
| Number of calibration concepts (optional) | 6 | 0 |
| Avoid dominated concepts | ✓ | ✓ |
| Include BYO in tournament | ✓ | ✓ |

The design settings for this research differed from Sawtooth's approximate guidelines mainly in response to the specific needs of the research or where feedback from the pilot studies suggested the requirements were undesirable.

One key difference was the number of combined attribute scenarios, known as 'concepts', within the screening stage. Sawtooth's recommendation is six tasks with four concepts each, totalling 24; but the researcher judged that the use of four concepts per page would appear too onerous and confusing for participants given the complexity of the issue being considered and the inclusion of images for each concept. Instead, it was decided to show just three concepts for each screening task.  For the first pilot, the number of screening tasks was increased to 8 to compensate (8 x 3 equalling 24), but it was found during this pilot study that 8 screening pages seemed too many for most participants and, consequently, the number was subsequently reduced to 6.  Whilst this reduced the total number of screening concepts to 18 (6 x 3), it was judged that the increased likelihood of participants completing the questionnaire was preferable to the possible increased robustness of having 6 extra concepts in total.

The number of maximum concepts for the choice tournament was also reduced from the approximate guidelines of  14 to 12, but this followed different guidelines for the software which recommends that '*you limit the number of concepts taken into the choice tournament  to a little over half of your product concepts*…'  (Sawtooth Software, 2013a, p441).

Once the design settings for the questionnaire were set, the next task was to construct lists for all the attributes and their levels.  In addition, lists were formed for all the non-ACBC questions, for example the demographics and questions concerning cumulative effects.

When considering all the possible concepts that combined the different attributes and their levels, it was important to confirm whether these would represent realistic scenarios and, if not, to prevent certain combinations cropping up within the questionnaire.  For this research, it was felt that two concepts should be excluded, identified within the software as 'prohibitions', as shown below in Table D.9.2.  These were excluded because, if a windfarm is seen upon backcloth hills, ie upon hills that are seen in the distance of a view, they cannot also be located nearby or in the middle distance.

<table>
<tr><th colspan="2">Table D.9.2:  Prohibitions for ACBC concepts</th></tr>
<tr><td rowspan="2">Attribute 2, level 4<br><br>Landscape type: Seen upon backcloth hills above a mixed landscape pattern</td><td>Attribute 4, level 2<br><br>Proximity: middle distance</td></tr>
<tr><td>Attribute 4, level 1<br><br>Proximity: nearby</td></tr>
</table>

For each of the attributes, the order of the levels needed to be determined, for example low to high, high to low, or none if the levels are nominal (which is particularly important when later carrying out the data analysis).  During review of the data for this research, an inconsistency became apparent which derived from the fact that the windfarm attribute levels had been set up in the software to be ordered from small to large without sufficient consideration of whether this equated to low to high scale effect.  So, whilst small wind turbines and small numbers of wind turbines represented a low level for scale effect, a small distance (nearby proximity) represented a high level of scale effect.  This was discovered too late in the process to change the set-up of the questionnaire, but it was nonetheless subsequently taken into account during the data analysis, for example when interpreting positive or negative correlations.

When setting up the questionnaire, it was necessary to identify which attributes should be included within the Build Your Own (BYO) section.  The purpose of this section is to question people up-front about their preferences before they have had to make trade-offs during the choice tournament. For this research, it was felt that preferences for the individual levels of each windfarm attribute were obvious (or 'no brainers'): that most people would think a windfarm with smaller wind turbines, fewer wind turbines, and further away would be less overbearing in scale[15]. This was supported by the findings of the first pilot study for which the windfarm attributes were included within the BYO. As a consequence, it was judged that no significant data would be obtained from including these three attributes within the BYO and that only the landscape type and context of experience attributes should be included within this part of the ACBC questionnaire.

Images for each of the combined concepts for landscape type and context of experience were included within the questionnaire (as discussed later). For the BYO, this allowed the software to show an image of the 20 different combinations of the two attributes and their levels as participants selected these on the BYO page of the questionnaire, as indicated below in Figure D.9.1.

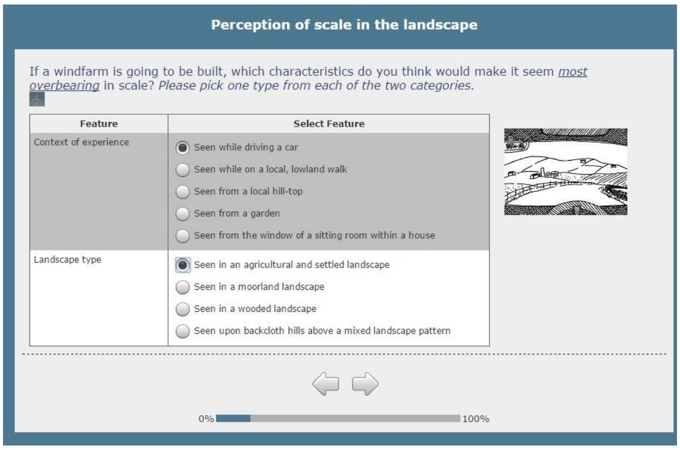



Figure D.9.1: Build Your Own (BYO) page of the ACBC questionnaire showing one combination selected based on one level for each of the two attributes

Although the windfarm attributes were not included within the BYO, it was felt that these should nonetheless be listed on the questionnaire page following the BYO task so participants would be fully aware of the full range of attributes and the levels of these (shown on page 8 of questionnaire copied in Appendix D.10).

Once the design settings for the questionnaire were confirmed, the software put together a basic structure which was accessed via the 'write questionnaire' window. This allowed the wording for the different page types to be accessed and confirmed, for example for the different screening and choice questions. It also allowed extra pages to be inserted that included just text for information, as set out previously in Table 4.6 of Chapter 4. Within some of the introduction pages and each of the BYO, screening and choice pages, a link was inserted (triggered by clicking a simple icon) to further explanatory guidance. This was included following the first pilot study as feedback suggested that there was too much

[15] Conversely, the main value of judgements on these attributes was their preference in combination

explanation included at the beginning of this version of the questionnaire, but participants nonetheless wanted to be able to access the information for reference.

The wording of all the questions was explored and confirmed after many iterations, including feedback from the pilot studies described later. Nonetheless, a key issue that had to be addressed at an early stage in relation to the specific research questions was: how could you ask participants to express what was most important to their preference of scale effect? This enquiry contrasted to many ACBC questionnaires that asked participants to just express a preference for a certain product such as a house or credit card. After considering carefully this difference of focus, it was decided that the key question for participants should be for them to choose what would be most likely to have a certain scale effect.

Once the nature of the question of scale effect was established, further exploration was required (including discussion during the first pilot study) to consider whether it was better to ask people to judge a negative or positive scale effect. General advice on questioning is usually to ask people what they think is good rather than bad. Nonetheless, in contrast for this research, earlier research had revealed that most people accepted that windfarms had some negative scale effects, but that some people thought that most or all windfarms had no positive scale effects. Thus it was feared that, if participants were asked to make a judgement of what scenario would have most positive scale effect, some might reject the questionnaire altogether; whereas most people would be willing to accept that different windfarms might have some negative effects. Following the other public attitude and preference study carried out for this research (described in 4.1 of the main thesis), the word selected to represent negative scale effect within the ACBC questionnaire was 'overbearing' (explained to participants within the introduction and guidance notes that accompanied the questionnaire).

To ease understanding and answering by the participants, all the questions concerning scale effect focused on which scenarios would be most likely to result in an overbearing scale effect. Nonetheless, because Sawtooth software was created principally to identify positive preference for a product (as is the most common requirement for marketing), rather than identifying negative effects, it did mean some of the default wording for some of the questions was awkward for use for this research. This was particularly the case for the 'must haves' and 'unacceptables' for which the software included defaults such as:

> *"Would any [product] having the features below be totally unacceptable? If so, mark the one feature that is most unacceptable to you, so I can focus better on the [products] that meet your needs".*

As evident from this wording, a simple transfer of words to this research would involve asking participants whether any attributes were unacceptable in creating a negative (overbearing) scale effect. To address this challenge, a number of different question texts were explored and tested with colleagues, allowing some improvements. Nonetheless, it was acknowledged that the wording for the 'unacceptables' and 'must haves' questions remained awkward, even after improvement. Unfortunately, this could not be resolved completely given the characteristics of the software, which required certain questions to be posed in particular ways in order for the answers to trigger the adaptive process of ACBC.

Within the ‘write questionnaire’ window, additional pages were also inserted within the questionnaire that included non choice-based questions, termed ‘select’ questions. These were used to question demographic information and also the scale perception questions that could not or did not need to be included within the ACBC part of the questionnaire as listed in Table 4.5 of chapter 4. The software allowed different formats to be set up for these questions, for example to allow participants to make a single choice, multiple choices (to a maximum number), or to choose their own suggestion which they named. For most questions concerning scale effect, participants were asked to choose the scenario that would appear most overbearing, but for one question concerning the cumulative extent of effects, participants were asked to select a point along a sliding scale where they felt an overbearing cumulative effect occurred.

The design settings for the questionnaire were tested by the software once returns were received for the first pilot questionnaire. This produced a table that summarised how many times each level appeared within each test respondent’s concepts, and confirmed whether these met the recommended minimum of 2 times or met the preference for 3 times or over.

### *D.9.2 Inclusion of images within the questionnaire*

The decision to include images within the ACBC questionnaire is described within section 4.3 of chapter 4 of the thesis. This choice was informed partly by published literature and partly by the use of images within the other methods of this research, particularly when communicating the nature of scale effects during consultation for the experiential landscape assessment.

Review of published literature highlighted some key issues with regards to the use of images in questionnaires. There are some contradictions between the findings of these publications, and some also focus on how well visualisations compare with objects or places in real life, rather than how well they represent specific attributes and aid judgement of effects. Nonetheless, some findings that were relevant to the use of images in the ACBC questionnaire are summarised below in Table D.9.3:

Table D.9.3: Key issues raised in published literature relevant to the use of images within conjoint questionnaires

| *Type of issue* | *Key findings or recommendations* |
| --- | --- |
| Type and composition of image, and depiction of attributes within images | • It is easier to control the contents of hand-drawn or computer-generated images compared to photographs.<br>• Photographs have been found (eg Stamps, 1990) to be a valid surrogate for a real view and thus are a useful tool, but they do not evoke the same perceptions as would be experienced in real life.<br>• Virtual reality may allow spatial and experiential characteristics to be conveyed better than in static images, but they raise issues concerning availability of software, ability of individuals to use large file sizes and the long time required to construct models.<br>• There is a need for an image to include contextual information to appear realistic, but elements of this may then distract attention from the attributes. Related to this, a key issue is whether people’s |

| Table D.9.3: Key issues raised in published literature relevant to the use of images within conjoint questionnaires | |
|---|---|
| *Type of issue* | *Key findings or recommendations* |
| | choices are based on just the attributes shown in the images or whether the contextual information affects their judgements. Furthermore, whilst images may be selected or constructed to represent strictly the differences between attribute levels, background information is often less easy to control within photographs and thus may be less consistent. As examples, some points raised during studies that were irrelevant to the task included the time of day, the weather, the number of people and cars shown (or not), the length of shadows, and the location of street furniture. Davies and Laing (2003) found that the season seen in images affected people's judgements, with spring and summer having a positive effect on judged use and safety of a place, whilst winter had negative effect.<br>• There are issues of ordering and bias control, as people notice differently the addition or omission of elements to scenarios, eg Davies and Laing (2003) found people rarely commented on the paving within images until it changed. Some participants seemed to focus upon the changes between images, almost like a 'spot the difference' competition, rather than on the effect being represented by the individual images. People may be particularly sensitive to this when the base image is of somewhere they know and some feature has been added or removed to how it is in reality.<br>• Images and words that represent types of attribute, or the experience of these, are limited in what they can convey because of needing to categorise types or showing sample viewpoints that are limited in number or range. This contrasts to the typical perception of scale or scale effects in the field, which is based upon numerous views and experiences from many locations, both static and mobile. |
| Selection of text or image, or combination of both | • Generally, the relative value of images or words depends upon the nature of the product to be judged and what and how images or words can be used to represent or describe its attributes.<br>• Most important is whether the participant possesses, from either images or words, the information they need to make a judgement. This leads to a further question of whether you need to tell people what the attributes are, or whether they can pick these up from images alone (Davies, Laing and Scott, 2002).<br>• Pictorial information tends to be less structured than the use of words, so it may be more demanding for the viewer to interpret, and this may lead them to focus upon fewer attributes within an image.<br>• Vriens *et al* (1998) state that images improved respondents' understanding of design attributes, whilst verbal representations seemed to facilitate judgement.<br>• Pictorial representations of a product tend to be of greater value if people judge the value of the actual product in reality mainly by its appearance or, alternatively, if they are unfamiliar with the product (for example because it is new) and thus they may be unsure of what |

| Table D.9.3: Key issues raised in published literature relevant to the use of images within conjoint questionnaires | |
|---|---|
| *Type of issue* | *Key findings or recommendations* |
| | is meant by a text description.<br>• Some researchers (eg Holbrook and Moore, 1981, and Vriens *et al*, 1998) have found images to prompt perception of a greater number of main feature effects compared with word descriptions, whilst others (eg Domzal and Unger, 1985) have found the opposite. Nonetheless, the difference between these is diminished when the words prompt a mental picture on which judgements are made. Domzal and Unger (1985) found that 'concrete words' (those that refer to objects, persons, places or things that can be seen, heard, felt, smelled or tasted) tend to prompt more visual imagery than abstract words.<br>• Vriens *et al* (1998) found that there was greater difference between responses when images were included, but that there was greater predictive accuracy when words were shown after images.<br>• Some researchers (eg Holbrook and Moore, 1981) believe a verbal description tends to be most useful for products that are utilitarian in nature, whilst images are more helpful when judgements depend primarily on aesthetics, symbolic meaning or sensory experience.<br>• Holbrook and Moore (1981) consider there is a key difference in how images and words are perceived and interpreted. They describe how pictorial information is processed simultaneously, which facilitates interpretation and evaluation of the components together, whilst words are filed and handled sequentially in an independent verbal system. Nonetheless, as above, some may translate verbal descriptions into a mental image, which diminishes the difference between these.<br>• The relative success of images or text to describe a product depends on how people use the information to make a judgement and how this may change during an exercise. It is not only relevant whether they process the information simultaneously or sequentially, as discussed above, but also whether they take any shortcuts, for example focusing on just one or two attributes because these are most important to them.<br>• Davies, Laing and Scott (2002) recommend including text details of the attributes and levels alongside images so participants can note more clearly the differences. Nonetheless Laing *et al* (2009) reported that respondents to a different study remarked that the text describing the attribute types and levels didn't add anything to the images shown. |
| Quality and comprehension of the images | • Although visual technology is improving, photo-realism is still limited.<br>• Participants often get distracted by focusing on the quality of the images themselves, rather than the effects being represented.<br>• Some participants of some studies complained about computer-generated images being unrealistic. For example, Davies and Laing (2003) included people within different images that appeared the |

| Table D.9.3: Key issues raised in published literature relevant to the use of images within conjoint questionnaires | |
|---|---|
| *Type of issue* | *Key findings or recommendations* |
| | same to be consistent, but then some respondents remarked about how unsuitable their clothes were in some of the weather conditions shown.<br>• With an electronic survey accessed via the internet, there is not any control over the size of screen viewed or the resolution, colour or brightness of the images. Furthermore, whilst including large images improves clarity, these may interrupt the flow of the questionnaire, for example separating the images from the instructions and response boxes To address this problem, Davies, Laing and Scott (2002) included small images within a questionnaire which they hoped people would click to enlarge or download, but they found most people did not do this and then complained that the images were too similar, small and dark. In addition, although they included a test page that could be used to amend the settings on the participants' computer monitors, few people undertook this task.<br>• Greatest consistency of digital images within a questionnaire is possible when all participants access this via a single computer, with the potential to also show large, bright images that can be seen quickly. Nonetheless, the costs, fixed location and restricted times of operation of this limits distribution and thus the range of possible participants of the questionnaire.<br>• Quite a few of the research studies reported in published literature were carried out with staff or students of architecture, landscape architecture or another design subject, who may have better than usual comprehension of representation by images. |

Building upon the review of published literature summarised in Table D.9.3 above in addition to the findings of the other research methods, four different options for including images or not within the ACBC questionnaire were considered during the first pilot study for the ACBC questionnaire: text only; image only; text and photograph; and text and line drawing. The findings of this exploration are summarised below in Table D.9.4:

| Table D.9.4: Exploration of using images and/or text for questions within the ACBC questionnaire | |
|---|---|
| *Depiction of attributes* | *Advantages or disadvantages* |
| Text only | • Difficult to judge scale effects within different scenarios of attributes with the provision of a text description only. This is particularly the case for the landscape type and experience of landscape attributes, as these attributes and their levels are more difficult to convey with words only (the number of words limited by the format and to ensure relatively quick completion). |
| Image only | • It is not easy to know what information you should draw from the images without a list of attributes alongside.<br>• Images alone cannot communicate some aspects of landscape experience, for example stimuli that are non-visual. |
| Images and text | • Combining images and text allows maximum understanding of |

| Table D.9.4: Exploration of using images and/or text for questions within the ACBC questionnaire | |
|---|---|
| *Depiction of attributes* | *Advantages or disadvantages* |
| | attributes by most people, with some attributes easier to convey in words, and some in images.<br>• Combining images and text allows some calibration between the attributes listed and those conveyed within the images.<br>• Inclusion of an image means that judgements by all participants are based on the same mental picture.<br>• Maximises understanding for different people that may be more familiar with either images or text. |
| a Photograph and text | • Photographs tend to include information that is superfluous to the issue being illustrated: scale effect. This can distract from the key elements that influence scale effect, but may also influence people's judgement of landscape value (for example one person in the pilot commented on the snow on the hills affecting 'attractiveness' and thus her judgement of scale effects in relation to these hills).<br>• The selection of photographs to depict all the different combinations of attributes requires a very large library of photographs to choose from.<br>• The portrayal of attributes using photographs is less consistent than drawings, as it is impossible to include photographs of landscapes or windfarms that only vary in the attributes defined, and no other characteristics such as light, weather and seasonal conditions as well as being similar in clarity.<br>• It is not possible in photographs to represent some aspects of human perception and experience that influence scale effects, for example size constancy.<br>• Photographs often do not convey the key landscape and visual features which would stand out to the viewer and which they might use as a cue for judging scale, for example the change in apparent texture of vegetation with distance. Furthermore, by appearing as a more realistic representation of a view than a sketch or drawing, viewers might not realise that they need to carry out additional perceptions of aspects of the image.<br>• Photographs are very poor for depicting wind turbines at a distance against a sky backcloth due to the low colour contrast. This means judgements of scale effect based on seeing wind turbines in photographs would likely be strongly influenced by perceived prominence. |
| b Line drawings and text | • Line drawings can focus on scale effect, omitting superfluous detail as shown in a photograph.<br>• A concern was that line drawings, with their clarity and prominence, may distract attention away from the text. Furthermore, by paring down the amount of visual information provided, a concern was that they could unduly lead participants' judgements. Conversely, respondents of the first pilot study reported that, by incorporating an initial 'filter' and reducing the amount of interpretation required, it meant that all participants would be basing their judgement on a more consistent starting point.<br>• Line drawings are judged more consistently because they do not include representation of temporary variables such as weather or light conditions.<br>• Computer generated images can appear less variable in style and more |

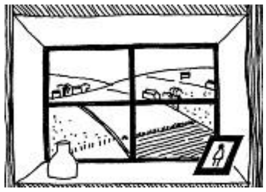
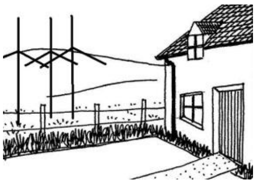
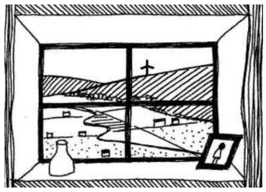
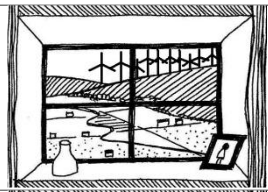
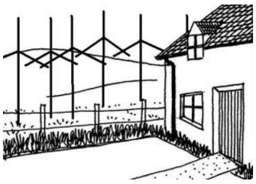
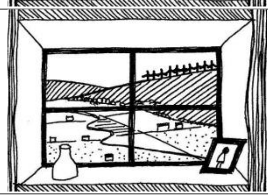
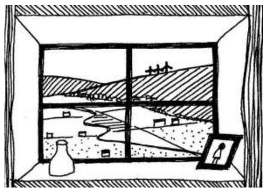
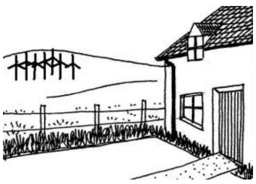
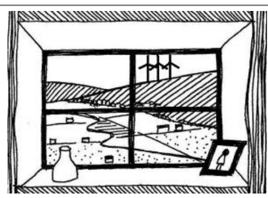
| Table D.9.4: Exploration of using images and/or text for questions within the ACBC questionnaire | |
|---|---|
| *Depiction of attributes* | *Advantages or disadvantages* |
| | consistent in their depiction of attributes than hand-drawn line drawings, but they can take a long time to prepare (depending on familiarity with the software) and can seem bland in their rendering.<br>• Basic line drawings are transparent in not trying to represent how a view will look in reality. In this way, they make it clear that the observer needs to interpret further the information provided, such as searching out the cues that might be used to perceive scale. |

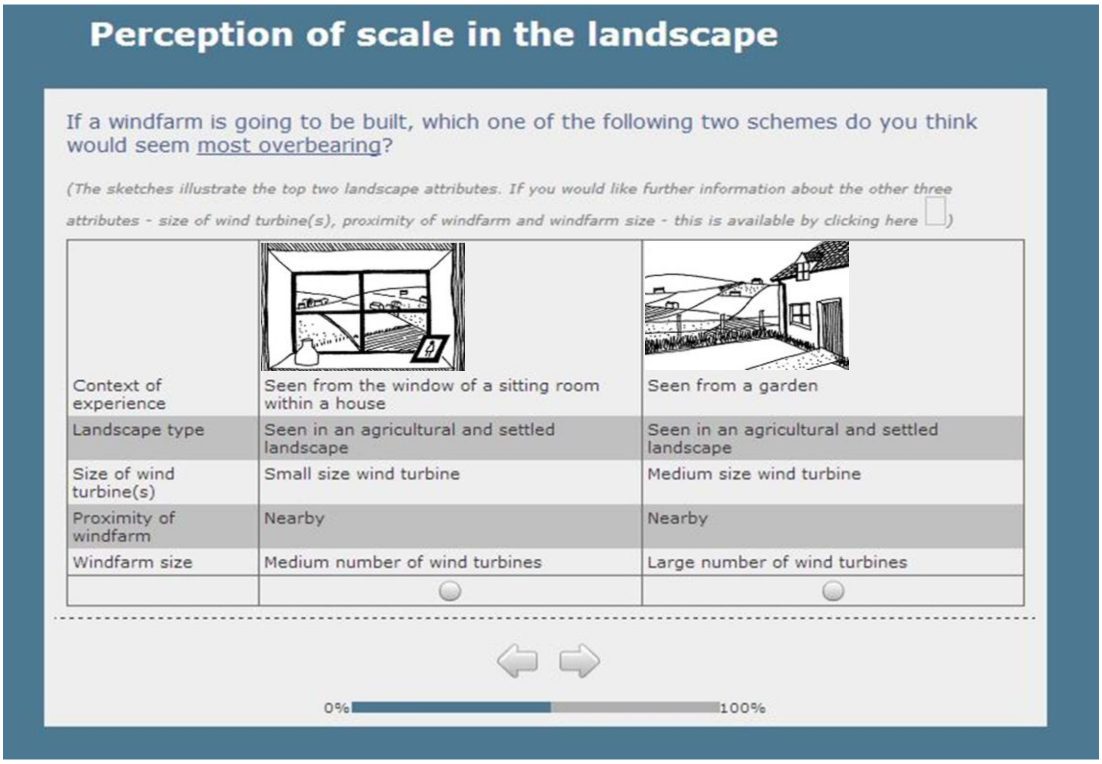
Following the assessment summarised above in Table D.9.4, it was decided that the ACBC questionnaire should include a combination of text listing the attributes with line drawings, but a key question to then address was whether all the attributes should be represented by line drawings or just some of them. This was raised for two key reasons: one, because the small size of the images required to fit the questionnaire format (that required images to be shown side by side) meant it was difficult to represent clearly some of the differences between some of the windfarm attributes (for example a medium-sized windfarm and large-sized windfarm at close proximity would both cross the field of view of the image); and, two, feedback from the first pilot study was that some participants feared they were sometimes making a judgement based on the attractiveness of the visual composition of the view when all the attributes were illustrated, rather than thinking consciously about how all the attributes would combine to create perceived scale effect. Table D.9.5 overleaf shows some of the images produced to explore the depiction of different windfarm attributes.

In discussion with participants of the first pilot study, it was felt that the priority should be to depict in the images the receiving environment (or baseline) for the windfarm - the landscape type and context of experience attributes - as these helped you to imagine the experience of being within a particular landscape. Nonetheless, in addition to these, there was some uncertainty to whether it would be possible for each participant to 'add in' themselves their prediction of the likely scale effect of the different windfarm attributes. To test this, the second pilot included images that showed the landscape type and context of experience attributes only and participants were asked after the questionnaire how easy it had been to make a judgement of scale effect. In addition, each participant was shown two different versions of one of the questionnaire pages showing this with or without wind turbines, as shown overleaf in Figure D.9.2, and asked for feedback. The consensus of the responses to this enquiry was that the drawings showing just landscape type and context of experience helped people to 'place themselves' within the environment described. Furthermore, they acknowledged that, even though it required quite a lot of effort to mentally 'add' the wind turbines, they felt this process helped them to estimate better the experience of the scale effect of the windfarm. This contrasted to the experience of making a judgement based on a complete image that included the wind turbines which most felt was quicker and easier, but was influenced more strongly by the visual composition of the image rather than predicting themselves how it would be to be in the location depicted and to experience the scale effect of the windfarm described.

Following the analysis described above, it was decided that line drawings would be included within the ACBC questionnaire for all the landscape type and context of experience attributes. To incorporate these drawings within an ACBC questionnaire, 'conditional graphics' had to be inserted within the Sawtooth software, requiring a separate drawing to be linked to each combination of attributes. This was so the questionnaire shows the appropriate image as the adaptive process brings-up any combination of landscape type and context of experience attribute. The 20 images representing the different combinations of landscape type and context of experience attributes are shown overleaf in Table D.9.6.

For the non choice-based part of the questionnaire, comprising what Sawtooth software identifies as 'select questions', it was decided that wind turbines would be included within the images. This was because the scenarios presented did not represent the standard range or levels of windfarm attributes and, alternatively, the images needed to be able to illustrate specific characteristics of wind turbine design, visibility or the presence of multiple developments.

| Table D.9.5: Example graphics for ACBC questionnaire including different types of windfarm | | | | |
|---|---|---|---|---|
| Landscape and experiential attributes | | | | |
| Windfarm attributes | Context of experience: Seen from a garden Landscape type: Moorland landscape | | Windfarm attributes | Context of experience: Seen from the window of a sitting room within a house Landscape type: Seen in an agricultural and settled landscape |
| No wind turbines |  | | No wind turbines |  |
| Small cluster of large wind turbines at close proximity |  | | Single wind turbine of medium size in the distance |  |
| Single, large wind turbine at close proximity |  | | Large windfarm of large size wind turbines in the distance |  |
| Medium-sized windfarm of large wind turbines at close proximity |  | | Large windfarm of small size wind turbines in the distance |  |
| Large windfarm, midground of view, medium-sized wind turbines |  | | Small cluster of small size wind turbines in the distance |  |
| Medium-sized windfarm, midground of view, medium-sized wind turbines |  | | Small cluster of large size wind turbines in the distance |  |



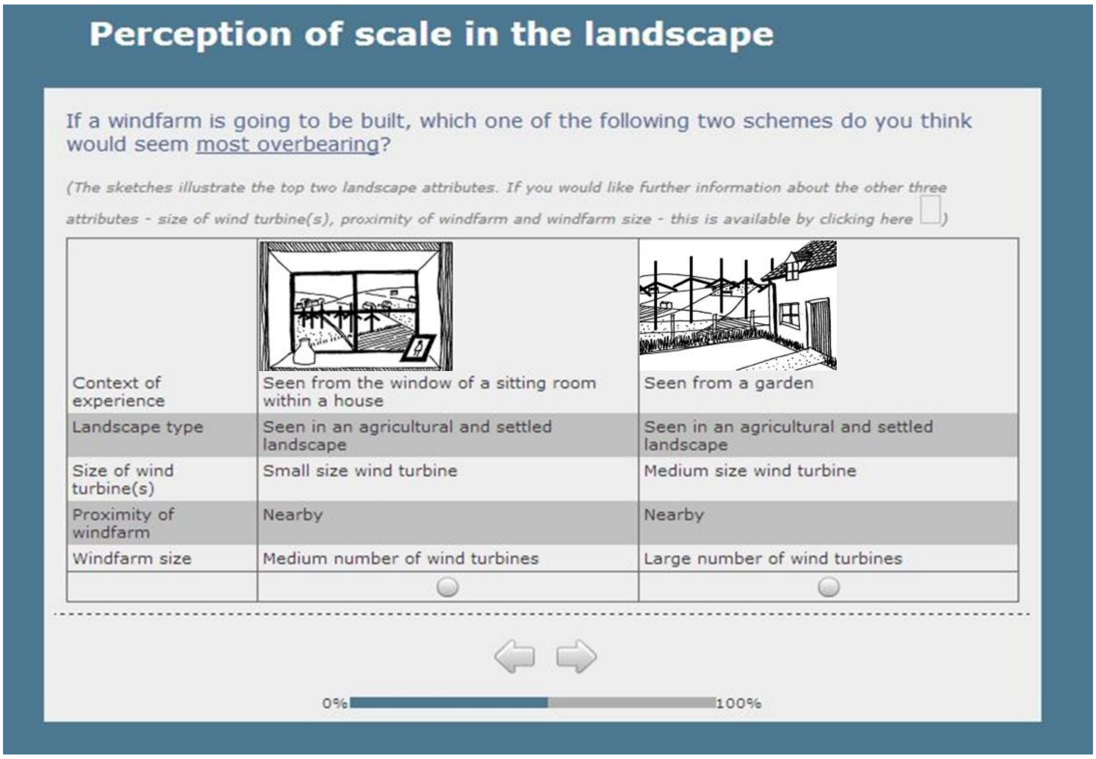
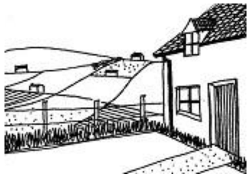
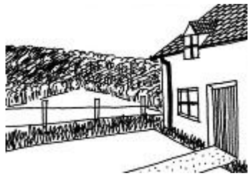
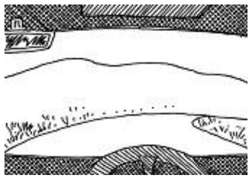
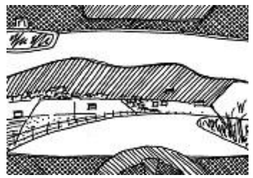
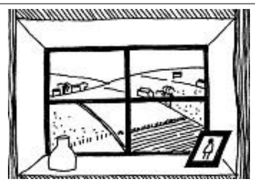
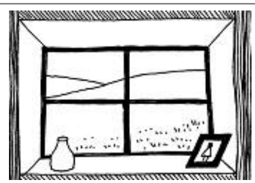
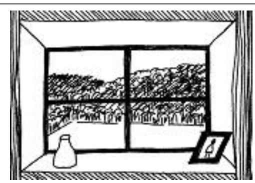
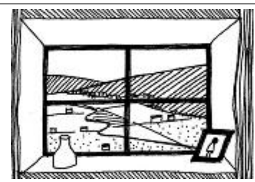




Figure D.9.2: Exploration using ACBC images with/ without wind turbines, tested during the second pilot study

| Table D.9.6: Conditional graphics for ACBC questionnaire Build Your Own (BYO) and choice-based questions* | | | | | |
|---|---|---|---|---|---|
| | | Landscape type attributes | | | |
| | | Seen in an agricultural and settled landscape | Seen in a moorland landscape | Seen in a wooded landscape | Seen upon the backcloth hills above a mixed landscape pattern |
| Context of experience attributes | Seen from a garden |  |  |  |  |
| | Seen while driving a car |  |  |  |  |
| | Seen while on a local, lowland walk |  |  |  |  |
| | Seen from a local hill-top |  |  |  |  |
| | Seen from the window of a sitting room within a house |  |  |  |  |

** Note: These images were not shown all together within the ACBC questionnaire; thus judgement of the different levels of effects were based on seeing up to two or three side-by-side, but not all together*

### *D.9.3 Pilot studies*

Three pilot studies were carried out to inform the development of the ACBC questionnaire. For the first and second pilots, the following Table D.9.7 summarises the scope of the study, the feedback received that was particularly relevant to further development of the questionnaire, analysis of this, and actions or amendments.

| Table D.9.7: Summary of scope of pilot studies and subsequent feedback and action | |
|---|---|
| ***Pilot 1*** | |
| *Description*:<br>• Paper copy of questionnaire adopting similar format to Sawtooth software questionnaire (but not adaptive).<br>• Six attributes (including distribution of windfarms attribute omitted later)<br>• Eight pages at beginning introducing subject, including terminology and nature of attributes.<br>• BYO table<br>• Four screening pages with 3 concepts each<br>• One Must Have page<br>• Six choice tournament pages.<br>• Demographic questions on age, occupation, attitudes and number of windfarms seen.<br>*Participants n=12* | |
| ***Feedback*** | |
| 1 | Need to reduce in length the introduction at the beginning because, although useful, was a bit off-putting. Move some of the information into a separate 'extra' guidance note for reference if necessary. |
| 2 | Participants questioned 'overbearing', so the choice of this needed to be explained. Some asked whether it would be better to judge a positive scale effect, rather than a negative effect, ie most modest or least overbearing. But participant experienced in CBC advised that his experience was that a negative judgement tends to be most successful for CBC. In addition, the trouble with using 'least overbearing' is that some participants (particularly those against windfarms) may think that this suggests a degree of overbearing effect may be acceptable. |
| 3 | Of alternative formats included, use of line drawings with text was preferred to using text only or including photographs. Discussion between participants confirmed that the inclusion of images meant that everyone was basing judgements on the same landscape baseline where words alone would have conjured up different impressions. Photographs showed too much detail, some of which was superfluous to scale issue, eg snow on hills mentioned as influencing perceived landscape value. |
| 4 | The drawings or photographs representing multiple windfarms were not clear within the scope of the ACBC questionnaire format, so these need to be considered by non-ACBC questions. |
| 5 | One participant questioned the scope for drafting drawings on computer, which might be quicker to produce and allow more standardized representation of windfarm attribute levels. For the researcher, though, hand-drawn line drawings are much quicker for her to prepare than computer-drafted drawings. The hand-drawn quality also highlights that the drawings are not meant to be a literal representation of effects and require interpretation by the viewer in reference to the text listing the attributes. |
| | |
| ***Pilot 2*** | |
| *Description:*<br>• Questionnaire similar to final issue, apart from some differences in wording and format.<br>• Viewed by participants on researcher's laptop and completed as would final questionnaire.<br>• Researcher provided no guidance to participant prior to starting questionnaire, so participants | |

| Table D.9.7: Summary of scope of pilot studies and subsequent feedback and action | |
|---|---|
| had the same amount of information as somebody that had received the questionnaire remotely via a link.<br>• The researcher sat behind the participant at a distance and observed them carrying out the questionnaire, so it could be seen which pages they pondered over and completed quicker or slower.<br>• The participants provided feedback after the questionnaire had been completed, responding to a standard structure of questions.<br><br>*Participants n=7, including professionals in the wind energy industry, landscape advisors and members of the public* | |
| ***Feedback*** | |
| 1 | Several respondents said they found the screening section hardest and this was the part which seemed to 'drag on' (and this was highlighted by the progress counter showing eg '6 of 8'). Most participants seemed to be fairly enthusiastic and determined up to about page 6 of this section. One option considered was breaking up the screening pages with an encouraging message part-way along, but feedback was that this might seem patronising and would break up the continuity and rhythm of answering. Decided to reduce screening pages to 6. This may reduce robustness of responses, but judged this was better than people not persisting with the questionnaire. |
| 2 | One respondent remarked they were not sure how a windfarm would be positioned upon the 'mixed landscape with backdrop hills', eg always on the skyline? Another wondered whether the description was of the hills creating a backcloth or the wind turbines being backclothed. Consequently revised description of this landscape type attribute needed to be clearer. |
| 3 | All the respondents remarked that the images helped. Some respondents added that the landscape type images are particularly useful as might otherwise have interpreted some of the landscape descriptions differently if they had had different regions in mind, for example an agricultural landscape in the Highlands or Cambridgeshire. |
| 4 | Most respondents said that they had no problem 'putting in the turbines' themselves, although one highlighted that it involved quite a lot of thought to review their 'mental images' of windfarms that they had seen in the past. When asked, many respondents said they thought including the wind turbines would have meant their decisions would have been quicker, but some raised that this might be because you would be judging the picture, rather than thinking about what the experience would be like of the scale effects. |

After feedback from the second pilot study and the incorporation of changes, a third pilot study was undertaken. For this, in contrast to previous exercises, the questionnaire was loaded on the University of Edinburgh computer server and a link emailed to participants, following as near as possible the process of circulating the final questionnaire. Indeed, the intention was that, if there were no significant problems encountered during distribution and completion of the third pilot study and following preliminary analysis of the data, the returns from this pilot would be included within the overall data for the final questionnaire.

For the third pilot study, the link to the questionnaire was sent to 38 potential participants. These included a range of different people representing the groups listed below who had been involved with the previous LVIA or experiential landscape assessment methods of the research and/or had expressed an interest in the research.

- Professionals involved with windfarm cases (including landscape architects);
- Local Authority planners;

- Members of the public;
- PhD students; and
- Members of the public/ professionals involved with windfarm opposition group.

Thirty-one of the third pilot study questionnaires were completed and submitted. The data from these were subsequently downloaded from the university server and preliminary data analysis carried out to check whether the questionnaire completion, data submission and data retrieval systems had all worked well.

Although there was not a formal process for obtaining feedback from the participants of the third pilot study, comments could be left within the comments text box at the end of the questionnaire. From these, no technical problems were raised and most reported that they had found the questionnaire both interesting and challenging[16]. Most of the negative comments made by respondents concerned the method of the ACBC, as listed in the bullets below. Nonetheless, what is interesting about these comments is that they actually highlight some of the great qualities of the ACBC process over conventional consultation, for example pushing people to make choices and not letting them add lots of qualifications such as ‘it depends…’

- *‘Interesting but difficult process (difficult to make 'black and white' decisions where both options appeared to be overbearing but maybe for different reasons’ (Respondent 6)*
- *‘On the questions where you are asked to say which of two options was the most overbearing I would have liked the option to say they were equally overbearing’ (Respondent 9)*
- *‘While a balance needs to be struck to make the questionnaire simple for all participants, I wanted to add more justification of my answers along the lines of “it depends on whether.....”’ (Respondent 30)*

Following review of the third pilot study questionnaire responses, it was confirmed that all the systems seemed to working well and that the preliminary data retrieved and analysed appeared to be robust and was not revealing any obvious anomalies. Consequently, it was decided that the final ACBC questionnaire should remain unchanged for its final distribution to all recipients.

[16] It was acknowledged that this sample was not representative of the general public or even the full range of recipients for the final survey, as they were all people that had expressed previously a strong interest in the research

## Appendix D.10: PDF copy of the ACBC questionnaire *(separate PDF copy on DVD)*

*Note: this in a format slightly different from the server-based original version, as it is not 'adaptive' and thus shows more options than realistic and includes code markings*

*(The original questionnaire can be accessed via* the following link:
https://www.survey.eca.ed.ac.uk/scaleperception/login.html )

## Appendix D.11: Copy of guidance accompanying the ACBC questionnaire *(separate file on DVD)*

*Note: The original guidance within the questionnaire had a link between the contents list and the headings and could be scrolled continuously, rather than broken into separate pages. (The original questionnaire can be accessed via the link shown above.)*

## Appendix D.12: Computer-generated wireline diagrams to inform LVIA and experiential landscape assessment *(separate PDF copy on DVD)*

# APPENDIX E:

***Chapter 5: Landscape and Visual Impact Assessment (LVIA)***

## Appendix E.1: Guidance from different editions of GLVIA regarding the assessment of scale effects

| Table E.1.1: Summary of guidance within the **second edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA2* | *Relevance or interpretation with regards to scale effects* |
| General | GLVIA2 highlights that, as part of Environmental Impact Assessment (EIA), Landscape and Visual Impact Assessment (LVIA) is important to inform both decision makers and the public about the effects of a development (pvi). | This means that scale effects, alike other effects, need to be conveyed clearly by the LVIA in a way that can be understood by both the public and professionals. |
| | There is flexibility in the method of a LVIA, as GLVIA2 does not comprise a set of rules. Alternatively, it explains that '*the methodology should be appropriate for the nature, location and scale of the project and the potential sensitivity of the site*' (p27). | This means there is flexibility in terms of the method of assessing scale effects, alike other effects, and this will need to be tailored to the characteristics of the site and the proposal. Nonetheless, to avoid uncertainty regarding the basis of assessment, the nature of this method needs to be described. |
| | References to scale within GLVIA. | It is important to highlight that GLVIA2 refers to 'scale' in two different ways: scale in terms of an attribute of a landscape or visual characteristic, but also scale in terms of a level of effect and, specifically, with regards to the level of magnitude of effect. |
| | GLVIA2 states that landscape and visual effects should be assessed separately. It distinguishes these as follows: landscapes effects as those that '*…derive from changes in the physical landscape, which may give rise to changes in its character and how this is experienced*', whilst visual effects '*…relate to the changes that arise in the composition of available views as a result of changes to the landscape, to people's responses to the changes, and the overall effects with respect to visual amenity*' (p12). | Within these definitions, is not always clear how to split the consideration of scale with regards to the landscape resource and the visual resource as there is obviously overlap between these two and care needs to be taken to avoid double-counting or aspects slipping between the two types. |
| | With regards to the levels of significance of effects, GLVIA2 stresses that these are not absolute but, instead, need to be defined with regards to a specific landscape and development (p92). It also explains how significance is a judgement based on the combined sensitivity of the resource and the magnitude of effects. In this respect, GLVIA2 states | Levels or type of scale effect, alike other effects, should be included within the definitions of various significance of landscape and visual effects. |

| Table E.1.1: Summary of guidance within the **second edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA2* | *Relevance or interpretation with regards to scale effects* |
| | that it is important to record the reasoning behind judgments being made so that this can be readily understood by decision makers and members of the public (p88). | |
| Design of structure and scope for mitigation | With regards to the design process, GLVIA2 highlights that it is expected that the process of LVIA will inform the iterative design process and '*… can help to avoid or minimise potential negative effects of the development'* (p13). Following on from this, GLVIA2 suggests that scale is a primary characteristic of a development and an attribute of the receiving environment, its location and nature of development (p33). With these, it describes how it is important to consider alternatives and mitigation measures to avoid, reduce and, if possible, offset any significant adverse effects on the environment (pp 33 and 43). | The scale of a development and the scale of the receiving environment should be assessed and alternative scales of development considered as part of the design process. If the scale of a development in relation to the scale of landscape or visual resource or the experience of these results in significant adverse effects, further mitigation should be applied to avoid, reduce or offset these effects. |
| Landscape baseline | GLVIA2 includes a general aim for the landscape baseline: *'… to record and analyse the existing landscape features, characteristics, the way the landscape is experienced, and the value or importance of the landscape and visual resources in the vicinity of the proposed development' (p65)*. It is also highlighted how this is important to inform the design process. | The scale of the landscape is not described explicitly within GLVIA2 with regards to assessing the landscape baseline; but it would be expected that it would be assessed as part of the general description of '*…existing features, characteristics, [and] the way the landscape is experienced, and the value or importance of the landscape and visual resources*…' |
| | GLVIA2 highlights that assessment of the baseline conditions includes identification of 'receptors'. These are elements or combinations of elements that will be directly or indirectly affected by the proposed development (p68). | Assessment of landscape receptors would need to consider aspects of the landscape that may be affected by the scale of a development (p12). |
| | With regards to understanding how people experience a landscape, for example qualities of scale, GLVIA2 highlights that it is *'…necessary to identify the landscape components that are valued by the community or society as a whole, why and how they are valued and, where possible, the people to whom they are valuable – that is "what matters and why"'* (p15). | To understand what and why landscape components are valued by a community or society, aspects of scale would need to be considered: both in terms of the nature of the landscape, such as sense of enclosure or intimate landscape pattern, or with regards to the experience of other qualities that may be affected by the scale of a development, such as a sense of refuge. |
| Sensitivity of | With regards to the sensitivity of the landscape resource, GLVIA2 | To establish the sensitivity of the landscape resource, the scale of the |

| Table E.1.1: Summary of guidance within the **second edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA2* | *Relevance or interpretation with regards to scale effects* |
| landscape resource | highlights that one of five key variables are '*the pattern and scale of the landscape'* (p87). It should thus be considered within respect to '*…the degree to which a landscape is able to accommodate change… without adverse effects on its character' (p16)*. | landscape would need to be assessed in relation to the proposed development. It would be important to explain any descriptions of scale categories, for example small, medium or large. |
| Visual baseline and sensitivity of the visual resource | GLVIA2 describes how it is necessary to consider the extent and nature of existing views and the nature and characteristics of the visual amenity of potentially sensitive visual receptors (p75). | Although GLVIA2 does not describe explicitly how the scale of the landscape should be assessed as part of the visual baseline, it would be expected that this should be assessed with regards to the general extent and nature of views and visual amenity. A key challenge may be making generalisations of how scale is viewed within a wide landscape, for example including enclosed, framed views or open views and from different elevations in relation to different topography and how these are experienced in combination. |
| | With regards to the sensitivity of visual receptors, GLVIA2 advises that '*more weight is usually given to changes in the view or visual amenity which are greater in scale, and visible over a wide area' (p91)*. | The use of the word scale in this instance is unclear with regards to whether it is referring to the scale of an object that makes a change or the scale or 'strength' of the effect of this change, ie the level of magnitude of effect. Nonetheless, given that this section concerns sensitivity of receptors, it can be predicted that the first option is meant and that the advice is that the sensitivity of visual receptors will depend on how large and extensive a change is. |
| Taking on board people's views | GLVIA2 highlights that it is important to identify the individuals or groups of people that could be affected by proposals because the landscape is valuable to people in different ways, for example those who live or work in an area in contrast to special interests or the wider public (p71). It also describes the importance of the context of how people experience views and visual amenity, for example different locations, time of day and purposes for being in a particular place (p90). Furthermore, it highlights that, although public views are often considered as being of greater value than residents' views, collective effects may occur within a community or locality (p90). | Assessment and understanding of how different people experience and value the landscape and visual resource with regards to the scale of characteristics and the perception of scale effects would be likely to require consultation with different people within the study area. As people do not always distinguish effects influenced by scale compared to other factors, it may be necessary to provide people with the tools to convey relevant information on scale. This information would need to cover different experiences of scale at different times, for example during different seasons or activities. |

| Table E.1.1: Summary of guidance within the **second edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA2* | *Relevance or interpretation with regards to scale effects* |
| | GLVIA2 highlights that the most sensitive receptors may include: those partaking in outdoor recreation whose attention is on the landscape; communities where a development affects the landscape setting or valued views; and occupiers of residential properties. | It can be useful to separate different users of a landscape with regards to sensitivity (p90-91), but it is important to understand that there would also be overlap between these, for example a local resident partaking in recreation and/or living or working within a community affected by a windfarm and/or travelling past a windfarm and seeing it from a residence. This means, with regards to scale, it would be important to highlight the combined experience of this whilst partaking in different activities. |
| Magnitude of effects | With regards to the magnitude of effects, GLVIA2 highlights that there are not standard measures of the different levels of effect. Nonetheless, in this regard it states this is generally based on '…*the scale or degree of change to the landscape resource*'. | Although in this section, once again, GLVIA2 seems to be using the word scale to mean the level of change rather than the scale of the development within the landscape, a slight concern is that users may take this as indicating that they only need to consider scale with regards to the first meaning. |
| | In paragraph 7.20 (p88), GLVIA2 explains how some landscape effects may be quantified, and gives an example of the number of trees lost, so people following the guidelines may assume the magnitude of effects would include consideration of the number of wind turbines seen and/or the amount of each wind turbine visible. | Although this paragraph provides an example of quantification of landscape effects using numbers of units, paragraph 7.21 describes the scale of effect again as the degree of change which, for scale effects, is not directly proportional to the quantity of elements such as the number, size or distance of wind turbines. This means that it may be difficult to present information on both quantities of elements and the different levels of effects without people being confused by an indirect relationship between these and thus how both influence a judgement of magnitude of effect. |
| | With regards to identifying potential sources of visual effects, GLVIA2 describes how it may be helpful to use simplified categories (p89) which include consideration of: '*the extent of the view that would be occupied by the development (degree of visual intrusion): full partial, glimpse, etc; the proportion of the development or particular features that would be visible: full, most, small amount, none; the distance of the viewpoint from the development and whether the viewpoint would focus on the* | As for landscape effects described above, combining both quantitative and qualitative data can be very challenging, although these are undoubtedly both influential. A risk of describing a range of influences may be that assessors include or focus upon some, but not all that are relevant. With regards to scale effects, this could mean that people focus on quantifiable aspects which are easier to assess, such as extent and numbers, rather than qualitative aspects, for example perceived |

| Table E.1.1: Summary of guidance within the **second edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA2* | *Relevance or interpretation with regards to scale effects* |
| | *development due to proximity… ; and whether the view is transient or one of a sequence of views…'* | imposition upon a sense of enclosure. The examples may also imply a direct relationship between these attributes and resultant effects when this is not necessarily the case. |
| | With regards to the magnitude of visual effects, reference to scale is mentioned with regards to the amount of change in a view, including the proportion of a view affected. | Although reference to scale is once again made largely with regards to extent of change, one of the categories of effect that is described nonetheless prompts consideration of scale effect as: '*the degree of contrast or integration of any new features or changes in the landscape with the existing or remaining landscape elements and characteristics in terms of form, scale and mass, line, height, colour and texture' (p91)*. Here it is clear that GLVIA2 is advocating assessment of *compatibility* of the development with the baseline conditions in regards to scale. |
| Significance of effects | With regards to the significance of scale effects on the landscape resource, there is no specific guidance included in GLVIA2. | Although scale effects are not mentioned specifically with regards to the significance of landscape effects, these could be judged following general guidance such as effects resulting in '*the loss of mature or diverse landscape elements, or features*…' (if this was a consequence of the scale effect). Furthermore, scale effects could be judged for their influence on distinctive or representative landscape character areas or '*the loss of landscape elements, features or characteristics'* or landscapes with a high sensitivity '…*to the type of change proposed'* (p94). |
| | There is specific reference to scale within GLVIA2 in terms of the significance of scale on visual effects, , including statements that '*large-scale changes which introduce new, discordant or intrusive elements into the view are more likely to be significant than small changes or changes involving features already present within the view'* (p95). | This guidance is helpful for not only mentioning the scale of effect, ie small and large, but also what the implications of this might be such as discordancy or intrusion. Nonetheless, a difficulty with this kind of description of just either end of the spectrum is that there is insufficient advice on the different effects and their thresholds that exist in-between and that are relevant to most developments. |

| Table E.1.2: Summary of guidance within the **third edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA3* | *Relevance or interpretation with regards to scale effects* |
| General | Within general guidance on the process of assessing receptor sensitivity and the magnitude and significance of effects, GLVIA3 describes how a judgement of sensitivity should be based on '*the susceptibility of the receptor to the type of change arising from the specific proposal; and the value attached to the receptor*'. It also describes how *magnitude should be made up of a judgment of*<br>• *'The size and scale of the effect – for example, whether there is complete loss of a particular element of the landscape or a minor change;*<br>• *The geographical extent of the area that will be affected; and*<br>• *The duration of the effect and its reversibility*.'(p38) | GLVIA3 (alike GLVIA2 described in Table E.1.1 above) refers to 'scale' in two different ways: scale in terms of an attribute of a landscape or visual characteristic; and scale in terms of a level of effect, particularly with regards to the level of magnitude of effect.<br>Following this general guidance, scale should be considered both in terms of the development proposed and the character of the receiving environment and receptor, and this will in turn influence susceptibility and sensitivity. With regards to the magnitude of effects, this guidance describes quantifiable aspects, but does not highlight the distinction between the scale of an effect, ie the level of magnitude, and the effect of scale. |
| Project description | GLVIA3 states that '…*the project must be defined in sufficient detail, even in an outline planning application, to allow its effects on the environment to be identified and assessed'* (p50).<br>It is highlighted that '*it is essential that the development proposals are clearly presented and illustrated'* (p55).<br>GLVIA3 describes how, through each stage of the project life cycle and '…*where relevant, for the various scheme components, a range of qualitative information will be valuable in giving a proper and proportionate understanding of what is proposed, to assist in assessments of landscape and visual effects'*. It describes how this may include '…*dimensions of major plant, buildings and structures, and landform features;…numbers of scheme components… and the design of scheme components (including layout, scale, style and distinctiveness'*. | Although this guidance suggests that a scheme should be described in sufficient detail for its effects to be identified and assessed, it does not acknowledge that different users will require different information to be able to assess effects. This is particularly important with regards to scale effects, as just describing the height, number and distance of wind turbines will not be sufficient for most people (both professionals and the public) to be able to make a judgement of scale effects. Nonetheless the second statement is useful for highlighting the need for clarity and that, to achieve this, illustration may be required in addition to description in words.<br>It is useful that GLVIA3 highlights that information on qualitative attributes of a development are required but, unfortunately, most of the examples given are quantitative and thus may not be as helpful as they could be. |
| Design of structure and scope | Within the scope of exploring alternative project designs, GLVIA3 states that the landscape professional should '…*usually expect to advise on a number of different alternatives*…' and these include '*alternative locations* | This guidance on the design process within GLVIA3 highlights that there is a need to consider alterative scales of a development and siting. |

| Table E.1.2: Summary of guidance within the **third edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA3* | *Relevance or interpretation with regards to scale effects* |
| for mitigation | *or sites; different approaches in terms of scheme design, or the size/scale/orientation of the proposed development'*. (p53) | |
| Landscape baseline | GLVIA3 states that the aim of the landscape baseline is to provide an understanding of the landscape in the area that may be affected: '*its constituent elements, its character and the way this varies spatially, its geographic extent, its history…, its condition, the way the landscape is experienced, and the value attached to it*.' (p32) | Within this section regarding the landscape baseline, GLVIA3 highlights usefully the importance of the spatial characteristics of a landscape and how these are experienced and valued which is essential information for understanding the scale of the landscape. |
| | GLVIA3 advises that establishment of the landscape baseline should be first through Landscape Character Assessment (LCA), including '*identify elements and features; identify landscape character and key characteristics; and consider value attached to landscape'*, showing how this leads to identification of the landscape receptors (figure 5.1, p71). GLVIA3 advises that although the LCA information required may be gained from existing LCA reports, new LCA assessment may be required for the LVIA and it acknowledges that '*existing assessments must be reviewed critically as their quality may vary, some may be dated and some may not be suited to the task in hand'* (p77). It goes on to say that, before relying on a LCA to inform a LVIA, this should be reviewed in terms of: '*when it was carried out and the extent to which the landscape may have changed since then; …the scale and level of detail of the assessment and therefore its suitability for use in the LVIA…; any other matters which might limit the reliability or usefulness of the information'* (p79). This leads to the statement that '*existing assessments may need to be reviewed and interpreted to adapt them for use in LVIA – for example by drawing out more clearly the key characteristics that are most relevant to the proposal. Fieldwork will also be required to check the applicability of the assessment throughout the study area and to refine it where necessary'* (p79). | This comprehensive advice provided by GLVIA3 is very important with regards to landscape character and what LCAs can offer, but may not, and thus require to be supplemented, because many of the LCA reports in Scotland are now very dated. It is not that the characteristics they describe are 'wrong', but that the original LCAs did not highlight some of the characteristics that are now very important to the scale effects of large structures. This is because the LCAs identified the characteristics that were particularly important to the 'forces for change' in the landscape at the time and, as structures such as wind turbines were only about one third the size as those now proposed (as described within chapters 1 and 2), LCA reports often do not identify the landscape characteristics or combinations of characteristics that are particularly sensitive to these larger structures. |
| | With regards to scale, GLVIA3 highlights that one of the aspects that LCA | This advice is very useful with regards to scale effects, particularly |

| Table E.1.2: Summary of guidance within the **third edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA3* | *Relevance or interpretation with regards to scale effects* |
| | should be used to identify and describe is '*the aesthetic and perceptual aspects of the landscape – such as, for example, its scale, complexity, openness, tranquillity or wildness*' (p74). | highlighting perceptual qualities of the landscape; nonetheless, a key challenge is that many of the LCAs in Scotland lack this information relevant to large scale developments such as windfarms currently proposed. |
| | GLVIA3 highlights that the landscape baseline should establish the value of the landscape; but that this is not just about recording designations and that '*value can apply to areas of landscape as a whole, or to the individual elements, features and aesthetic or perceptual dimensions which contribute to the character of the landscape*' (p80).<br>GLVIA3 states that '*where there is no existing evidence to indicate landscape value, and where scoping discussions suggest that it is appropriate, value should be determined as part of the baseline study through new survey and analysis. This requires definition of the criteria and factors that are considered to confer value on a landscape or on its components*' (p84). | The advice of GLVIA3 is very important with regards to the value of the landscape, as perceptions of scale such as a sense of enclosure or exposure may contribute to the character of the landscape and be highly valued by a community. Nonetheless, as highlighted by the second paragraph opposite, if these qualities are not described (which is typically the case outside designated areas as LCA does not apply value judgements), GLVIA places responsibility on these values being identified through EIA scoping and for people to recognise the value of aspects of scale within the landscape. |
| Landscape receptors | After establishing the baseline of the landscape resource, GLVIA3 advises that the different landscape receptors should be identified as: '*the components of the landscape that are likely to be affected by the scheme… such as overall character and key characteristics, individual elements or features, and specific aesthetic or perceptual aspects*'. It adds that a second step is to '*…identify interactions between these landscape receptors and the different components of the development…* (p86). | Although GLVIA3 does not refer directly to scale with regards to landscape receptors, this general advice would require the scale of the landscape to be considered as part of the baseline. This would include the scale of physical and spatial characteristics as well as the perceived scale of these. It is useful that the guidance highlights that, as well as individual elements, it is important to assess the interactions between these, particularly with regards to scale as the perception of this is always judged relatively. |
| Sensitivity of landscape resource | GLVIA3 outlines how landscape receptors need to be assessed '*…in terms of their sensitivity, combining judgements of their susceptibility to the type of change or development proposed and the value attached to the landscape*' (p88). | This section of GLVIA3 regarding the sensitivity of the landscape resource highlights how a judgement of susceptibility depends on the type of change proposed, which would require consideration of the scale of a development. |
| Visual | GLVIA3 states the aim of the visual baseline is '*to establish the area in* | This guidance in GLVIA3 regarding scale and the visual baseline is |

| Table E.1.2: Summary of guidance within the **third edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA3* | *Relevance or interpretation with regards to scale effects* |
| baseline | *which the development may be visible, the different groups of people who may experience views of the development, the places where they will be affected and the nature of the views and visual amenity at those points*'. (p32)<br><br>With regards to scale, GLVIA3 details how the baseline report should include information on *'the visual characteristics of the existing views, for example the nature and extent of the skyline, aspects of visual scale and proportion, especially with respect to any particular horizontal or vertical emphasis, and any key foci'* (p111). | useful, particularly by highlighting the need to consider '…visual scale and proportion' and how visual elements may be seen collectively and to have greater emphasis in one direction or plane. |
| Visual receptors and sensitivity | Within the baseline study, visual receptors are identified as the people within the study area who will be affected by changes in views and visual amenity as a consequence of a development (p106). GLVIA3 highlights that '*people generally have different responses to changes in views and visual amenity depending on the context… and purpose for being in a particular place (for example recreation, residence or employment, or passing through on roads or by other modes of transport)*' (p106). It also highlights that certain activities may be specifically associated with the experience and enjoyment of the landscape.<br><br>GLVIA3 says that the type of viewers that will be affected by a development and the places from where they will be affected should be identified (p106). It also advises that the viewpoints from which a development will be seen by these different groups of people should also be identified.<br><br>GLVIA3 advises that the visual receptors most susceptible to change are likely to include: '*residents at home; people, whether residents or visitors, who are engaged in outdoor recreation... whose attention or interest is likely to be focused on the landscape and on particular views;… communities where views contribute to the landscape setting enjoyed by residents in the area'* (p113). | This advice within GLVIA3 is comprehensive. With regards to scale effects, highlighting of the range of visual receptors is very important because a judgement of scale is typically developed through multiple experiences. It is also useful that the description of visual receptors within GLVIA3 does not focus upon representative viewpoints from which there are wide open views of a landscape and proposed change, such as hill tops, upon which attention was often focused in past LVIAs. Alternatively, it describes how it is important to consider the full range of views experienced by different viewers involved in different activities. This is particularly important when assessing scale effects because these may be greater from places where views are not open and a sense of imposition may be influenced by perceived affordances for different users of the landscape. |

| Table E.1.2: Summary of guidance within the **third edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA3* | *Relevance or interpretation with regards to scale effects* |
| Taking on board people's views | GLVIA3 states how consultation is an important part of the LVIA process and that '*it has a role in gathering specific information about the site, and in canvassing the views of the public on the proposed development. It can be a valuable tool in seeking understanding and agreement about the key issues, and can highlight local interests and values which may otherwise be overlooked. With commitment and engagement in a genuinely open and responsive process, consultation can also make a real contribution to scheme design*.' (p43) It also describes how well-organised and timely consultation can be of benefit to LVIA '*in providing better understanding of the landscape and of local attitudes to it. In its most useful form, participation in consultation will improve the quality of the information influencing the scheme design, and may result in positive changes to the design*.'(p45).<br><br>With regards to establishing the landscape baseline, GLVIA3 states '…*it is important where possible to draw on information and opinions from consultees. Consultations with local people or groups who use the landscape in different ways may, where practicable, also suggest the range of values that people attach to the landscape. Scoping discussions with the competent authority should help to determine the reasonable extent of such consultation*.' (p85) | It is useful for GLVIA3 to highlight how consultation can contribute positively to the assessment of baseline conditions and receptors, as well as scheme design, as contact in the past with communities regarding proposed development has often involved presentation of findings rather than a '…genuinely open and responsive process...' With regards to scale, this provides the scope for better understanding of the sensitivities of an area to different scales of development. Nonetheless, this kind of consultation relies on very thoughtful and sensitive engagement with consultees. In addition, with regards to scale, this may require providing sufficient tools for people to understand the relevance of scale to resulting effects, for example illustrating different schemes at different scales and explaining how this will affect the resulting scale effects.<br><br>The caveat attached to consultation with local people or groups of '*where practicable'* is ambiguous, as people's perceptions of practicable will vary and this may be used as a 'get-out' for avoiding consultation. Similarly, consultation through EIA scoping varies considerably between planning authorities and at different times, depending on staff capacity; thus it may be over-optimistic to rely on the scope of suitable consultation to be set through this process. |
| Identifying landscape effects | GLVIA3 describes how landscape effects are likely to include: '*change in and/or partial or complete loss of elements, features or aesthetic or perceptual aspects that contribute to the character and distinctiveness of the landscape; addition of new elements or features that will influence the character and distinctiveness of the landscape; combined effects of these changes on overall character'* (p86).<br><br>With regards to changes in landscape character or quality, GLVIA3 describes how these effects need to be '...*described as fully as possible and illustrated by maps and images that make clear, as accurately as* | GLVIA3 usefully describes not only landscape effects that tend to be obvious, but also those that might be less conspicuous but tend to influence strongly scale effects, such as perceptual aspects and distinctiveness as well as combined effects. It also highlights that these effects need to be described comprehensively and clearly and that this will influence people's understanding. This is particularly important when considering scale effects because, as described previously within chapters 1 and 2, although we know scale effects are important, people are often unable to interpret the information provided to judge |

| Table E.1.2: Summary of guidance within the **third edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA3* | *Relevance or interpretation with regards to scale effects* |
| | *possible, what is likely to happen.'* It highlights this further by stating '*good, clear and concise description of the effects that are identified is key to helping a wide range of people understand what may happen if the proposed change or development takes place'* (p88).<br><br>With regards to judging whether effects are positive or negative GLVIA3 suggests two possible tests: '*the degree to which the proposal fits with existing character; the contribution to the landscape that the development may make in its own right, usually by virtue of good design, even if it is in contrast to existing character'* (p88). | scale effects.<br><br>The guidance within GLVIA3 on judgement of positive or negative effects is very useful with regards to introducing large scale structures as this suggests that this depends on compatibility with existing character or, if not compatible, the virtues of good design. Nonetheless, with regards to the latter, it does not describe further what would be considered 'good design' which would be important to establish with regards to scale effects. |
| Identifying visual effects | Visual effects concern the effects of change and development on the views available to people and their visual amenity. This regards '…*how the surroundings of individuals or groups of people may be affected by changes in the content and character of views as a result of the change or loss of existing elements of the landscape and/or introduction of new elements'* (p98).<br><br>When assessing visual effects, GLVIA3 highlights a number of issues to be considered, including: *'the nature of the view of the development, for example a full or partial view or only a glimpse; the proportion of the development or particular features that would be visible…; the distance of the viewpoint from the development and whether the viewer would focus on the development due to its scale and proximity or whether the development would be only a small, minor element in a panoramic view;… the nature of the changes, which must be judged individually for each project, but may include, for example… alteration of visual scale, and change to the degree of visual enclosure'* (p112).<br><br>With regards to assessing whether visual effects are positive or negative, GLVIA3 advises this will be based on a judgement about '…*whether the changes will affect the quality of the visual experience for those groups of people who will see the changes, given the nature of existing views'* | This guidance within GLVIA3 on the nature of visual effects is comprehensive. Nonetheless, behind general guidance such as that included within the first paragraph opposite are a very high number of different scenarios of different effects, including scale effects.<br><br>Whilst the guidance in GLVIA3 is useful regarding issues to consider when identifying visual effects, some of the examples provided may prompt description of quantities rather than the resultant effects. For example, the distance of a viewpoint may not be relevant compared to whether a feature is perceived to be close, far away and/or imposing in distance.<br><br>It is useful for the guidance to make reference to visual scale and enclosure, although it is not clear how 'visual enclosure' would vary from spatial enclosure and whether this is just describing visual elements that appear to indicate spatial enclosure.<br><br>GLVIA3 seems to set the criterion for a judgement of effects being positive or negative on whether these enhance the quality of the visual resource in contrast to the criterion for landscape effects which concerns compatibility (described above) or representation of 'good design'. With regards to scale effects, this test is ambiguous, as the |

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|---|---|---|
| *Category* | *Advice provided by GLVIA3* | *Relevance or interpretation with regards to scale effects* |
| | (p113). | word quality is not necessarily good or bad: it requires qualification. |
| Magnitude of effects | GLVIA3 describes for both landscape and visual effects how the magnitude of effects on receptors needs to be assessed in terms of its size or scale, the geographical extent of the area influenced, and its duration and reversibility' (p90 and p115).<br><br>With regards to landscape effects, GLVIA3 explains how judgements of size or scale refer to the level of '…*change in the landscape that is likely to be experienced as a result of each effect'*. It expands this explanation to list some examples of what needs to be taken account of, such as '*the extent of existing landscape elements that will be lost, the proportion of the total extent that this represents and the contribution of that element to the character of the landscape*…' and adds that this can sometimes be quantified. It also includes '*the degree to which aesthetic or perceptual aspects of the landscape are altered either by removal of existing components of the landscape or by addition of new ones*…' and includes some examples such as the introduction of tall structures to change perceived openness (p90). Finally, it lists '*whether the effect changes the key characteristics of the landscape, which are critical to its distinctive character'* (p91).<br><br>With regards to visual effects, GLVIA3 describes how the size or scale of magnitude of effect needs to take account of: '*the scale of the change in the view with respect to the loss or addition of features in the view and changes in its composition…; the degree of contrast or integration of any new features or changes in the landscape with the existing or remaining landscape elements and characteristics in terms of form, scale, mass, line, height, colour and texture; the nature of the view of the proposed development, in terms of the relative amount of time over which it will be experienced and whether views will be full, partial or glimpses'* (p115).<br><br>With regards to GLVIA3's advice to include consideration of geographical | With regards to the magnitude of effects, including scale effects, GLVIA3 refers to 'scale' with regards to the level of '…*change in the landscape that is likely to be experienced as a result of each effect'*. Nonetheless, it also mentions 'scale' with regards to the nature of effects, for example the degree of contrast in '…*in terms of form, scale, mass, line, height…'* (p90) so that the distinction between these different uses of the word scale is not always clear. This is particularly the case when examples for levels of magnitude of effect include quantifiable aspects such as the extent and/or proportion of elements.<br><br>It is very useful that GLVIA3 describes how the magnitude of effects can be influenced by changes to perceptual qualities such as openness or to distinctiveness to character and not just quantifiable or physical effects which are often easier to identify. Furthermore, it is useful that GLVIA3 explains that the geographical extent of effects is distinct from the size or magnitude of effects and that effects may also need to be considered at various levels (or 'scales'), such as the local or regional level. |

| Table E.1.2: Summary of guidance within the **third edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA3* | *Relevance or interpretation with regards to scale effects* |
| | extent within a judgement of magnitude of landscape effect, it explains that the geographical area over which the landscape effects occur are distinct from the size or scale of the effect and these effects will occur over a variety of scales from the site level to an area including several landscape character areas (p91). | |
| Significance of effects | To judge significance of effects, GLVIA3 explains how the separate judgements of sensitivity and magnitude of effects need to be combined. It says that the rationale for this overall judgment must be clear, demonstrating how the assessments have combined to determine overall significance of effect (p91). GLVIA3 explains '*there are no hard and fast rules about what makes a significance effect, and there cannot be a standard approach since circumstances vary with the location and landscape context and with the type of proposal* (p92 and p116). The guidance describes what may be at the opposite ends of the spectrum of most or least significant, but does not indicate the thresholds of levels in-between and just says that a full explanation needs to be given for significance falling within this zone.<br><br>For the judgement of significance of visual effects, GLVIA3 includes the advice: 'large-scale changes which introduce new, non-characteristic or discordant or intrusive elements into the view are more likely to be significant than small changes or changes involving feature already present within the view' (p116). | Following general guidance within GLVIA3, it would be expected that scale effects should contribute to the judgment of the significance of effects. Nonetheless, GLVIA does not detail clearly how the combination of very different effects of a scheme, including scale effects, should be considered together, for example taking into account the relative importance of each and thus their contribution to an overall significance of effects. Without this information, a concern is that a judgement of overall significance may be made by 'averaging' the whole range of effects even if some of these may be so great individually that they set a minimum level for the overall significance of effect. This is particularly relevant to the assessment of scale because, if the scale of a development results in adverse significant scale effects, then a scheme may be unacceptable whatever the type and level of other effects.<br><br>As for GLVIA2, the description of the range of effects influencing significance of visual effects is helpful for not only mentioning the scale of effect, ie small and large, but also what the implications of these might be such as discordancy or intrusion. Nonetheless, a difficulty with this kind of description of either end of a spectrum is that there is insufficient advice on the different effects and their thresholds that exist in-between and that are relevant to most developments. |
| Presentation of visual effects | A LVIA report, as part of an EIA, should include: a description of the relevant baseline conditions; *'systematic identification and description of the potentially significant effects that are likely to occur'*; and a | The general guidance within GLVIA3 is useful for highlighting how effects, which would include scale effects, need to be described clearly. In addition, it highlights that the ES should describe mitigation |

| Table E.1.2: Summary of guidance within the **third edition of GLVIA** relevant to the assessment of scale effects | | |
|---|---|---|
| *Category* | *Advice provided by GLVIA3* | *Relevance or interpretation with regards to scale effects* |
| | description of mitigation measures to reduce significant adverse effects (p138).<br><br>GLVIA3 highlights that '*the choice of appropriate presentation techniques is crucial to good communication'*. To be clear, it advises that '…*standard definitions should be provided for any technical terms that are used*…' (p138).<br><br>With regards to the visual baseline, GLVIA3 describes how '*existing views should be illustrated by photographs or sketches with annotations added to emphasise any particularly important components of each view and to help viewers understand what they are looking at'* (p112). | measures for any potentially significant effects which would also apply to potential adverse scale effects.<br><br>GLVIA3 does not specify a particular way in which effects should be described or illustrated within a LVIA report but, conversely, highlights that the most appropriate methods would need to be selected to aid communication for each scheme. This is particularly important with regards to scale effects, as raised previously in chapters 1 and 2, as these can be very difficult to convey and different methods may be more or less suitable for different purposes and people. |
| Cumulative effects | There are many different scenarios by which cumulative effects can occur; nonetheless, GLVIA3 suggests that the focus of cumulative assessment will be on '…*the additional effect of a project in conjunction with other developments of the same type*…' (p122). With regards to the different timings of schemes that have the potential to have cumulative effects, GLVIA confirms that the baseline should include those schemes which are existing or under construction (p122): schemes with planning consent (but not built) or for which a planning application has been submitted but not determined should be considered as just potential schemes, alike other potential changes that may affect the landscape in the future (p123).<br><br>GLVIA3 highlights that cumulative landscape and visual effects may result from a number of different project scenarios, including: an extension to an existing development or incremental change as a result of successive individual developments (pp124-125).<br><br>Generally the same approach should be taken for assessing cumulative effects as that followed for the effects of an individual scheme in terms of assessing the sensitivity of the landscape and visual resource and magnitude and significance of effects. Nonetheless GLVIA3 highlights that | GLVIA3 describes comprehensively and clearly how cumulative effects should be assessed. Nonetheless, there may be a large range of different scenarios of potential developments or landscape change in which a proposed development may be introduced and thus need to be assessed. The different planning statuses of schemes are very important with regards to the different scales of developments, for example the size and numbers of existing wind turbines within an area. Another consideration is also the planning timescales of these schemes, as most windfarms only have consent for 20-25 years and will then be repowered by larger machines that also need to be at wider spacing (which may increase the extent of the overall development or require reduction in the number of wind turbines to stay within the original site boundary). This means that 'matching' a windfarm to an existing development may be inappropriate if this will be repowered shortly.<br><br>It is useful that GLVIA3 highlights the limited scope to mitigate cumulative effects. This can increase the susceptibility and sensitivity of a landscape to a proposed development. For example, even a well-designed windfarm of appropriate scale may have adverse significant |

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|---|---|---|
| *Category* | *Advice provided by GLVIA3* | *Relevance or interpretation with regards to scale effects* |
| | there may be a notable difference in terms of scope for mitigation of cumulative effects because '*as these effects arise from a number of different developments they cannot necessarily be addressed by measures related only to the main project being considered*' | effects where seen in a landscape which already contains other wind turbines that are of inappropriate scale. |

## Appendix E.2: Site assessment of the scale effects of a range of operational windfarms

| Table E.2.1: Examples of different proportions of wind turbine in Scotland | | | |
|---|---|---|---|
| Windfarm name/ location | Height of tower (m) | Blade length (m) | Percentage of blade length to tower height |
| Findhorn (original), Moray | 17 | 7 | 41% |
| Findhorn (extension), Moray | 30 | 14 | 47% |
| Skelmanae, Aberdeenshire | 50 | 24 | 48% |
| Dundee, Angus | 80 | 40 | 50% |
| Novar (extension), Highland | 70 | 36 | 51% |
| Novar (original), Highland | 35 | 18.5 | 53% |
| Boyndie, Banff & Buchan | 65 | 35.5 | 55% |
| Buolfruich, Highland | 40 | 22 | 55% |
| Craigengelt, Stirlingshire | 80 | 45 | 56% |
| Dalswinton, Dumfries and Galloway | 80 | 45 | 56% |
| Hagshaw Hill (original) | 35 | 20 | 57% |
| Hagshaw Hill (extension) | 49 | 31 | 63% |
| Kilbraur, Highland | 70 | 45 | 64% |
| Glens of Foudland, Aberdeenshire | 47 | 31 | 66% |
| Cairn Uish, Moray | 60 | 40 | 66.6% |
| Causeymire, Highland | 60 | 40 | 66.6% |
| Crystal Rig, Borders | 60 | 40 | 66.6% |
| Fairburn, Highland | 60 | 40 | 66.6% |
| Farr, Highland | 60 | 40 | 66.6% |
| Paul's Hill, Moray | 60 | 40 | 66.6% |
| Tullo, Aberdeenshire | 60 | 40 | 66.6% |
| Whitelee (original), Renfrewshire | 65 and 70 | 45 and 40 | 69% and 57% |
| Methil, Fife | 110 | 83.5 | 76% |

| Table E.2.2: LVIA Stage C: List of attributes identified through site assessment as being sensitive to the scale effects of windfarms | |
|---|---|
| **1** | **Wind turbine type** |
| 1.1. | Human scale reference to wind turbine size |
| 1.2. | Ratio/ proportion of blade length to tower height |
| 1.3. | Wind turbine blades |
| 1.4. | Typical orientation of wind turbines to key views |
| 1.5. | Turbine lights |
| 1.6. | Turbine colour and texture |
| **2.** | **Range of wind turbine size** |
| 2.1. | Turbines of varying size at varying distance to viewer |
| 2.2. | Proportion of height variation of different sized wind turbines |
| **3.** | **Pattern and extent of windfarm(s)** |
| 3.1. | Extent of windfarm: distance between nearest and furthest wind turbine, features that extend through windfarm site |
| 3.2. | Horizontal extent of windfarm seen around viewer |
| 3.3. | Layout and turbine spacing affecting perception of windfarm scale |
| 3.4. | Extent of wind turbines in relation to extent/ proportion of open space |
| **4.** | **Landscape pattern and its effect in perceiving distance** |
| 4.1. | Elements of landscape pattern and nature and extent of pattern |
| 4.2. | Distribution of elements of landscape pattern |
| 4.3. | Simplicity of landscape pattern and simplicity of texture of ground cover |
| 4.4. | Clarity of wind turbine form in relation to landscape pattern and visual backdrop |
| **5.** | **Relationship between windfarms and other vertical features** |
| 5.1. | Relationship between windfarm and other vertical features |
| 5.2. | Vertical features as key characteristics of landscape character and visual composition |
| 5.3. | Sense of imposition influenced by size and distance of wind turbines |
| 5.4. | Sense of imposition influenced by landform |
| 5.5. | Scale of spaces created by other vertical features |
| 5.6. | Character of other vertical elements |
| **6.** | **Shape and scale of the landform** |
| 6.1. | Landform characteristics/ feature of relevant scale to windfarm |
| 6.2. | Vertical emphasis of landform |
| 6.3. | Distinction of landform feature(s) |
| 6.4. | Proportion of windfarm scale to landform scale |
| 6.5. | Vertical emphasis of edges |
| 6.6. | Character of skyline in relation to landform |
| 6.7. | Distance to skyline |
| 6.8. | Range, character and scale of landform features that form backdrop to views |
| 6.9. | Windfarm siting upon landform slopes |
| 6.10. | Scale of isolated landform features |
| 6.11. | Collective relationship of multiple windfarms to landform features |
| 6.12. | Range of wind turbine height and extent of multiple windfarms in relation to landform |
| **7.** | **Number and rotation of wind turbine blades** |
| 7.1. | Number of blades |
| 7.2. | Blade rotation speed |
| **8.** | **Elevation of visibility** |
| 8.1. | Relative elevation of windfarm and key viewers |
| 8.2. | Distance of key viewers and angle of view |
| 8.3. | Combined elevation of windfarm/ wind turbines upon landform feature |
| **9.** | **Distance, access and vantage points** |
| 9.1. | Distance of windfarm from viewer |
| 9.2. | Distribution of vantage points within area of windfarm, eg at varying distance and |

| | |
|---|---|
| | orientation |
| 9.3. | Use of access routes and vantage points within area |
| 9.4. | Accessibility to human scale references of windfarm |
| 9.5. | Approaches to windfarm |

# APPENDICES F

*CHAPTER 6: Experiential landscape assessment*

## Appendix F.1: Example of interim report for case study presenting the findings of the experiential landscape assessment (Case study A: Dalswinton)

An example is provided on the following pages of an interim report for one of the three case studies, A: Dalswinton, an area of an existing windfarm. The interim reports included the main findings of the experiential landscape assessment, informed by both semi-structured interviews with local people (professionals and members of the public) and site assessment. They also included some findings of the LVIA stage D assessment of the sensitivities to scale effect within the case study areas as these overlapped or were directly relevant.

For the interim reports, all landscape and visual effects were described, not just scale effects, as it was judged that it was beneficial to present a wide context to the scale effects within the landscape and to also describe a wider landscape composition that would be more easily recognisable to participants. Each of the interim reports sent out to participants for comment also included an introduction, a summary of the method and information upon the next steps of the research.

### *Extract of interim report of case study A: Dalswinton, an area with an existing windfarm*

The following interim report draws out the key landscape and visual characteristics and qualities of the Nithsdale area and explains how these tend to be experienced. This information is structured within five categories, as listed below:

a A mixed landscape composition and pattern

b A hill backcloth to the valley

c Context of larger hills, plateaux and moorland interior

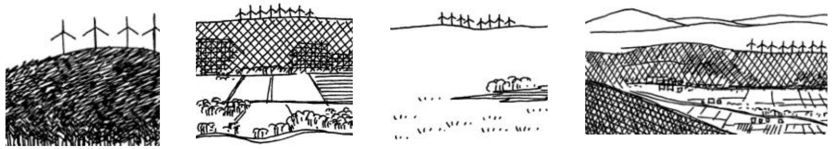
d Prevalence of trees and woodland of varying character

e Varying experience and vantage points across the Nithsdale landscape

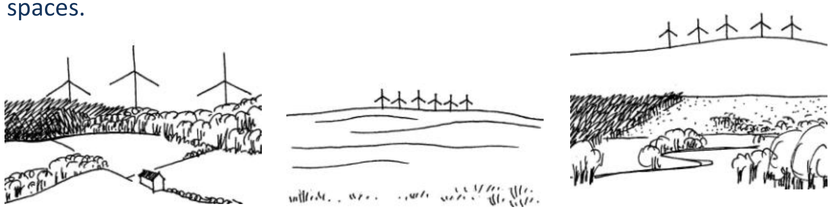
For each of the categories, Table F.1.1 overleaf includes in the left-hand column a description (black-coloured text) of the key landscape and visual characteristics and qualities and how these are experienced and valued. In addition, directly opposite in the right-hand column, it includes a description (blue -coloured text) of the existing effects of the Dalswinton windfarm in direct relation to these characteristics and qualities and how they are experienced.

Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm

**a) A mixed landscape composition and pattern**

| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
|---|---|
| Nithsdale comprises a **mixed composition of landscape types** that combine within the **encircling edges of surrounding hills.** Within this composition, there is **lots of variety within a relatively small area**. The perceived **distinctiveness of this area relates strongly to the balance between these different components and experiencing them together**, with different horizons and tiers to the landscape often revealing themselves as you move through and up and down slopes within the landscape. At a broad level, the mixed composition includes the valley floor, side slopes and backcloth hills, with the River Nith and its tributaries providing a consistent link throughout, leading to the sea. It has been stated that "*things fit together quite comfortably*"[17] within Nithsdale and that it represents "*a microcosm of Scotland as a whole*"[18]. At a finer level, there is also a **mixed landscape pattern** of settlements, woodland, agricultural land and moorland.<br> | The Dalswinton windfarm is mainly seen as a feature upon the backcloth hills of Nithsdale (discussed later within section b), so that the wind turbines do not seem to directly encroach upon all the different landscape types. Nonetheless, it is **seen from and in relation to the different types when travelling through various parts of the landscape**, for example seen in some views beyond a foreground of agricultural fields and, from elsewhere, beyond forested slopes.<br>On account of the windfarm being seen frequently in relation to a mixed landscape pattern, and thus rarely in isolation, its **prominence is often diminished**. However, by being seen from a number of different landscape types, it can appear **as a unifying feature that seems to reduce the variety and distinctiveness of the different landscape types** within the area.<br><br>*By being experienced in relation to many different landscape types, the windfarm is perceived as reducing the differences between these types and thus the distinction of the area as a whole* |

[17] Closeburn Community Council (2013)
[18] Keir Community Council (2013)

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **a) A mixed landscape composition and pattern** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
| The variation in land cover and landform results in **different characters of spaces**, from wide open hill ridges, to small, sheltered field enclosures. The elevated ground seems much larger in scale and there is a strong sense of exposure, while the lower-lying semi-enclosed spaces seem more intimate and shielded, often with a resulting sense of tranquillity.<br><br>*Different character of spaces and sense of enclosure within the landscape* | Within the various characters of space, Dalswinton windfarm has strongly contrasting effects. From upland areas, it tends to be **seen in relation to the larger scale landform** features and surrounding open space, and thus seems fairly modest in scale (unless at close proximity). In contrast, from the lower-lying, smaller scale and/or semi-enclosed areas, the windfarm is often screened; but, where seen from here, it tends to appear more imposing due to its **perceived intrusion upon the enclosure of the spaces**, partly due to the movement of blade rotation and, in some places, noise. In between these extremes, the effects of the windfarm are strongly affected by the perceived separation or 'set back' of the windfarm from the enclosed spaces.<br><br>*Varying sense of imposition upon different scales of spaces within the landscape and the sense of enclosure or exposure* |
| Within the Nithsdale landscape, there is **consistently strong evidence of human influence and interaction,** although the landscape is predominantly rural in character. The way in which the **landscape pattern represents this human influence varies**, often in relation to site specific physical conditions, and graded from more intensive land use and larger-scale structures within low-lying areas to less intensive and smaller scale structures within upland areas. This ranges from areas of intensive farming within the valley floor, to | The Dalswinton windfarm appears to **relate to the obvious influence of humans within the Nithsdale landscape**. In addition, by being located upon elevated slopes, it seems to relate to its specific function of harnessing the wind, and its concentrated form allows it to appear visually 'manageable' within views of the wider landscape. Nonetheless, its presence upon the hills contradicts the characteristic pattern of having more intensive land use and larger scale structures within the valley floor, and thus appears |

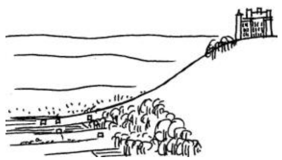
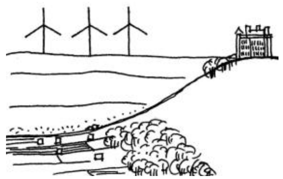
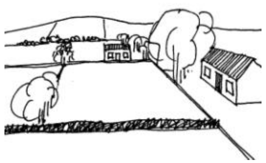
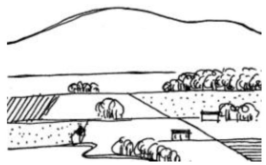
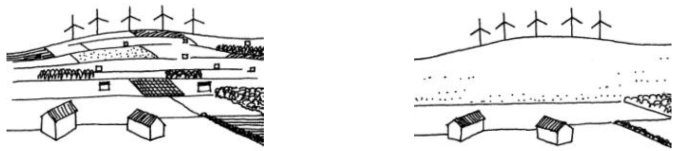
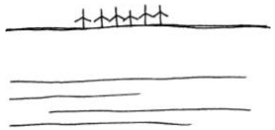
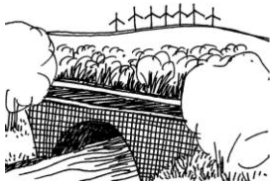
| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **a) A mixed landscape composition and pattern** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
| designed historic landscapes, to settlement at bridging points, and extensive grazing and forestry on elevated slopes. This relationship between people and the landscape is long established within the area, as evident by the high number of **archaeological and historic features** that add a sense of history and continued record within the area.<br>  <br>A distinctive characteristic of Nithsdale is its grand historic houses, which form foci and landmarks in the landscape, as well as designed grounds and policy woodlands that extend from these into the wider landscape pattern. | incongruous. In addition, while the windfarm **relates to the presence of other large scale human elements** within Nithsdale, such as forest plantations and telecom masts, it **adds to the cumulative effects** of these, such as increasing visual complexity.<br>As a feature that reflects renewable energy production, the Dalswinton windfarm may appear as a **contemporary addition to the long history of land use** within Nithsdale. However its character may also seem **incongruous and distracting where seen within the setting of archaeological and historic features**, for example if it appears disparate in scale or disturbing in its blade movement and noise, or seems incompatible with the specific design intentions of a designed landscape or feature. This can be a particular problem where the feature is oriented towards the windfarm, for example from a principal outlook from a castle. In addition, a windfarm may appear 'defiant' if it seems larger and/or more elevated than a historic feature whose special qualities relate in part to its prominence or perceived 'dominant' or defensive position.<br> <br>*Castle has overbearing position – the perception of strength derived in part by its larger size and greater elevation overlooking the landscape below*<br>*Windfarm seems to diminish defensive position and character of castle by appearing larger in scale and more elevated* |

Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm

**a) A mixed landscape composition and pattern**

| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
|---|---|
| Within areas of mixed landscape pattern, **landscape elements can act as size and distance indicators that aid perception of the scale of the landscape**. This is in contrast to moorland and forest areas with simple land cover, within which it can be very difficult to perceive scale and distance. Where views occur over a contrast of pattern, elements within one area may be used for size reference for an adjacent area, even if they are actually of very different scale; for example the perceived vertical scale of backcloth hills (see section b).<br><br>*Pattern of landscape elements aids scale perception*<br><br>*Simple land cover means it is difficult to discern scale of landscape*<br><br>*Contrast of pattern results in elements of one area being used for size reference for an adjacent area* | The Dalswinton windfarm is **typically viewed from the Nith valley which has a distinct landscape pattern, but is seen upon backcloth hills that are simple in land cover**. This tends to have three main affects: one, the windfarm seems **less imposing upon the smaller scale landscape elements** within the valley floor, as there is visual separation from these; two, with a lack of pattern upon the hills, **scale reference for the windfarm tends to be extrapolated from fore and midground features within views**, but this means that the reference may vary, depending on the fore and midground context of views; and, finally, because the valley floor landscape pattern does not extend all the way to the windfarm, it is difficult to perceive the distance of this feature and thus provide reassurance to the viewer that it is far away.<br><br>*Varying scale reference with fore and midground features changes perceived scale of windfarm and the apparent distance and separation of this from the viewer* |
| As a consequence of the mixed composition and pattern of the landscape, **reference features or places** tend to be very important to people – indicating both orientation and location. These **reference points occur at various scales**, from local bridges and historic buildings, to woodland blocks and distant hill peaks. They are particularly important for people where | The Dalswinton windfarm acts as a **new landmark and reference feature** within Nithsdale – this effect amplified by its scale and elevation upon the backcloth hills. While the windfarm **forms a fairly simple focal feature** when seen from a distance and while travelling along the main roads through Nithsdale, the scale and elevation of the wind turbines and their |

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **a) A mixed landscape composition and pattern** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
| views are intermittently screened and/ or to mark progression in relation to the sequence of places along the Nith valley.    | prominence tends to **distract views away from the previous foci** within the area. This is partly because the windfarm appears disparate in scale and position, as a large and elevated feature. As such, where seen in the distance, it often draws views away from more localised, foreground and/or smaller scale focal features. The **ever-changing image of the wind turbines in different light and weather conditions** also means that they continue to be **highly noticeable over time**, even with increased familiarity of their presence (see section e).   *From some locations, seen in isolation, the windfarm appears as a fairly simple focal feature. However, from other locations, it distracts views away other foci and landmarks, particularly within the foreground – many of which are important historic and cultural features as well as reference points within the area.* |

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **b) A hill backcloth to the valley** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
| The hills surrounding Nithsdale form an **obvious edge and backcloth to the** | From the Nith valley, the Dalswinton windfarm tends to be **seen upon the** |

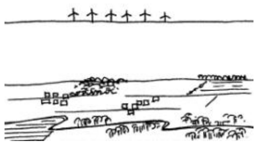
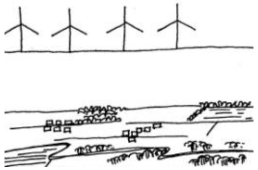
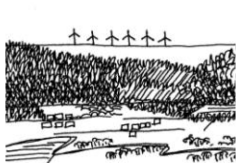
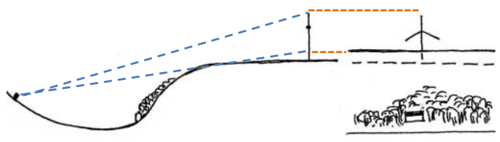
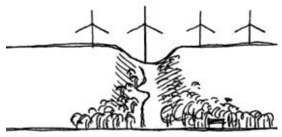
| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **b) A hill backcloth to the valley** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
| **valley floor**, highlighting the contrast between the two - a distinctive quality of the area. In some places, the difference of slope and land cover between these adjacent areas is very stark and the **backcloth hills themselves form a key landscape feature**; however, in other locations, the transition between the valley and its backcloth seems more gradual, with intervening lower hills and a patchy landscape pattern.<br><br>*Hill backcloth and edge to valley floor marked by contrast of slopes and land cover*<br><br>*Hill backcloth and edge to valley floor more graded*<br>The **convex slopes of the backcloth hills landform typically limits visibility from below** to the larger hills, plateaux and moorland interior beyond. | **top of the hill backcloth**. Where there is a strong contrast of form and land cover between the hills and the valley below, the location of the windfarm upon the hills may **amplify this contrast and emphasise the distinction between the backcloth hills and the valley**. However, from a distance, the windfarm can also appear to **impose upon the backcloth hills as a distinct feature**, especially where the wind turbines appear to be more than about one third the visible elevation or horizontal extent of the hills (whose actual physical elevation may be masked partially by vegetation).<br><br>*Wind turbines appear of minor vertical scale to hill backcloth*<br><br>*Wind turbines appear of major vertical scale to hill backcloth*<br><br>*Visible proportion of wind turbines and hill backcloth influenced by forest cover*<br>The convex nature of the hill backcloth typically means that it is **unclear how high or distant the Dalswinton wind turbines are** when viewed from below. Often, the viewer doesn't realise that they are not seeing the total height of the wind turbines, as well as perceiving them to be located upon the 'front' edge of the hill backcloth, when they are actually located far beyond. This **confusion of perceived scale and distance due to landform screening** is, however, eased in some places where there is a dip in the skyline, for example due to a tributary glen. In these circumstances, an |

Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm

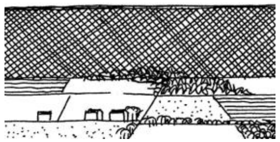
**b) A hill backcloth to the valley**

| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
|---|---|
| | image of the full wind turbine form and distance is revealed, which is then used to extrapolate the perceived scale and distance of the other wind turbines.<br><br>*Wind turbines appear shorter than they are because it is unclear from below that they are located far beyond the 'front edge' of the landform horizon*<br><br>*Dip in horizon reveals true height and distance of wind turbine, from which the viewer extrapolates the scale of the other turbines*<br>This highlights that the sense of imposition of the Dalswinton windfarm upon the adjacent valley below varies in relation to landform and land cover characteristics that may be distant from the site itself, but form the 'front edge' to the backcloth hills apparent in views. |
| The backcloth hills tend to be seen **collectively as forming a ridge or plateaux with overall horizontal emphasis** and **no particular top appearing of greater focus** than others. In this way, it is not always clear which stretch of the hill ridge you are looking at; but, conversely, the undifferentiated character of the hills do mean that these are able to form a simple visual backdrop that highlights and doesn't distract from the patterned landscape below. | The Dalswinton wind turbines, with their vertical emphasis, **contrast fairly simply to the horizontal form of the collective ridge of backcloth hills**. Seen upon this ridge, the windfarm appears as a **focal feature and landmark**, contrasting to the otherwise lack of dominant foci (although there are a few minor foci such as telecom masts) and marking a particular place along the linear hill range. |

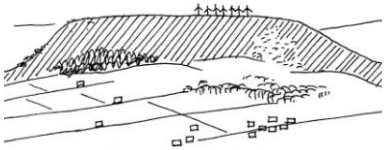
<table>
<tr><th colspan="2">Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm</th></tr>
<tr><th colspan="2">b) A hill backcloth to the valley</th></tr>
<tr><th>Key characteristics and qualities and how these are experienced and valued</th><th>Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued</th></tr>
<tr><td>


The hills themselves are not very high (typically between 200m and 300m elevation); however, their vertical dimension is often emphasised in contrast to the horizontal reference of the valley floor below. In addition, the hills are often perceived to be higher than their dimensions warrant because of an absence of features of definite size located upon their tops or upper slopes that would illustrate to the contrary. Even where forest plantations occur upon the hills, their vertical scale is not obvious as the canopy cover of these plantations tends to be so dense and indistinct that they prevent clear perception of the underlying ground and distances.

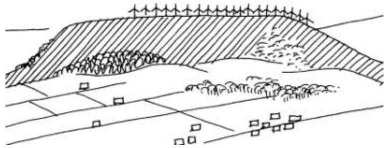
Land use upon the slopes of the backcloth hills tends to contrast with that upon the flatter valley floor below, reflecting a difference of soil, drainage, aspect, and other growing conditions and access. The pattern of this vegetation tends to be simpler and often of darker colour which can mean that the slopes may seem to



With simple backcloth hills, focus tends to be upon the skyline or foreground
</td><td>
The windfarm appears sufficiently restricted in its extent that it does not seem to dominate the overall horizontal scale of the hill backdrop; however, it does seem to diminish the perceived height of the hills by acting as a scale indicator that highlights their relatively low elevation.

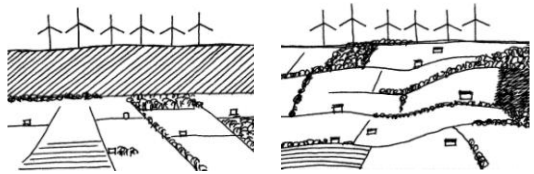


Windfarm creates simple focal feature, typically not appearing sufficiently extensive to dominant the horizontal dimension of the hills

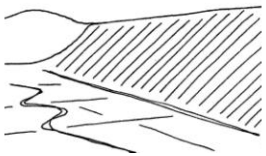
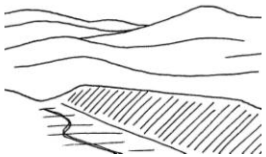
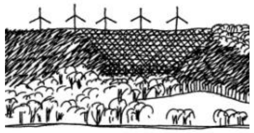
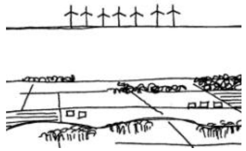
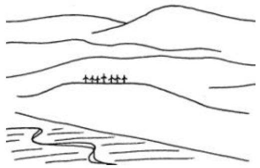


If the windfarm was larger or extended, it could dominate the horizontal dimension of the hills and seem more encroaching upon its surroundings

Where there is a clear contrast of land use and slope between the backcloth hills and the valley floor below, and thus the skyline stands out as a prominent feature, the Dalswinton windfarm tends to appear more prominent upon this. Where the wind turbines appear partially screened by the landform, their form can seem more confusing and thus imposing upon the character of the skyline as a feature, although this tends to be diminished upon wooded skylines. In other circumstances, the contrasting land cover, which emphasises the vertical aspect of the backcloth hills, may also stress the vertical dimension of the wind turbines.
</td></tr>
</table>

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **b) A hill backcloth to the valley** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
| visually recede within views in relation to the adjacent sky/lowland.<br>By appearing as a single block, **the slopes may also appear more 'two-dimensional' and vertical** in emphasis, in contrast to their surroundings; this can result in views tending to focus upon the **skyline as a key landscape feature**. | <br>*Wind turbines can seem to confuse the simple skyline feature*<br><br>*Emphasis of the hill backcloth by a contrast of vegetation may, in turn, seem to emphasise the vertical dimension of the wind turbines. This is in contrast to the effect with a gradually rising landform and consistent land cover* |

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **c) Context of larger hills, plateaux and moorland interior** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
| Whilst the backcloth hills described in b above appear as a clear linear ridge and edge when viewed from the Nith valley below, from higher elevations they can be **seen within the context of larger hills, plateaux and moorland interior**. Within these views, the hills, plateaux and moorland seem to extend far into the distance as a **series of receding tiers of elevated landform horizons**. Within this wider setting, although the backdrop hills still appear to form the edge of the valley below, their **character seems** | Although the Dalswinton windfarm appears to relate directly to the backcloth hills when viewed from the Nith valley below, from more elevated and distant viewpoints, it is **seen within the context of a larger hill, plateaux and moorland interior**. Viewed within this wider setting, its position can seem more transitional, located in-between the settled landscapes of the valleys and the more open and exposed moorland and hills (from some places to the north west or south east appearing to form a |

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **c) Context of larger hills, plateaux and moorland interior** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
| **more transitional**, lying in-between the settled valley and larger scale and more elevated interior.<br> <br>*From closer and low-lying locations, the backcloth hills appear to form a landform edge; however, from further away and more elevated viewpoints, it can be seen that these hills lie in-between the valley floor and larger scale hills, plateaux and moorland*<br><br>The larger hills, plateaux and moorland interior **contrasts in its character to the lower-lying and settled parts of Nithsdale,** particularly in terms of being larger in scale, with a strong sense of exposure. The landscape is simpler in pattern than the valley below, reflecting in part the fact that it is largely uninhabited and managed only extensively. It does, however, include a **number of very large conifer plantations** that contrast strongly in their form, colour, texture, enclosure and lines and clearly **convey human influence.**<br>  | 'book end' to the hills at the edge of the Nith valley). Seen within this context, the windfarm may seem **less imposing in scale due to appearing to relate to the larger scale hills, plateaux and moorland,** particularly if these actually appear higher than it within the view; this is despite the fact that the wind turbines often look taller within these open views, as their full height is revealed. While not imposing in scale, the windfarm can nonetheless seem **intrusive upon the character of the larger hills, plateaux and moorland interior** as it forms a feature within the open landscape that seems to have no obvious limits or boundary.<br>  <br>*Dalswinton windfarm is seen within many different landform contexts. While most clearly visible from elevated and more distant viewpoints, its scale tends to appear more minor within the setting of the larger hill, plateaux and moorlands beyond*<br><br>Although the Dalswinton windfarm **relates to the scale of the larger hills, plateaux and moorland interior and the exposed 'wind-swept' character of this area**, the wind turbines **contrast in their vertical line and regularity of pattern** against the curved hill landform horizons, and the **rotation of wind turbine blades tends to appear incongruous** in a landscape that seems otherwise typically fairly inactive. In addition, the windfarm has **cumulative effects in combination with existing conifer plantations** – particularly in |

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **c) Context of larger hills, plateaux and moorland interior** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
| | terms of their complexity of shapes and obvious human influence. |
| Although the larger hills, plateaux and moorland around Nithsdale does not constitute 'wild land' as defined by National policy[19], mainly because of human features and land use, and occurring upon the edge of a settled valley, this area nonetheless possesses **qualities of 'wildness'** as defined by policy. These are appreciated when looking towards the area from outside, as well as when actually upon the hills, plateaux and moorland itself. <br>In fact, by being located relatively close to settled places, this area offers the **valuable (and apparently contradictory) qualities of both ease of access to a large population and experience of wildness qualities**.<br><br>**A number of existing windfarms** are visible from the larger hills, plateaux and moorland interior, particularly to the north west, north and north east. These can diminish the qualities of wildness, particularly where seen within an open area of moorland or hills from which built development within neighbouring glens is screened by the landform. | The Dalswinton windfarm does not appear completely incongruous to the character of the larger hills, plateaux and moorland interior, due to the **presence of other human elements**, particularly existing conifer plantations. Nonetheless it does **diminish the sense of wildness experienced upon these hills**, especially from areas where other human elements appear more discreet or are screened by the landform. Reduction in the qualities of wildness results from not only visibility of the wind turbines, but also because of perceived disturbance to the experience of the landscape from blade rotation and noise, as well as visibility of associated infrastructure such as access tracks.<br><br>**Dalswinton windfarm tends to be seen on its own within local views** from the Nith valley as there are no other windfarms currently located in close proximity, helping it to appear to form a **fairly simple isolated landscape** |

[19] Scottish Natural Heritage (2002) Wildness in Scotland's Countryside

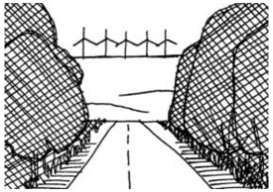
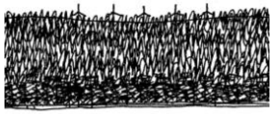
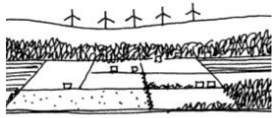
| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **c) Context of larger hills, plateaux and moorland interior** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
|  | **feature**. However, within some elevated views from the hill, plateaux and moorland interior, it is seen in addition to other windfarms, for example from Queensberry with Harestanes, Clyde and Wether Hill windfarms. In comparison with these, Dalswinton possesses some similarities with Wether Hill in terms of its form and relationship to landscape character; however it appears of **strongly contrasting character to Clyde and Harestanes** - particularly in terms of its extent and layout and relationship to landscape character. This results in a **complex cumulative effect when the schemes are intervisible from high points and where viewed sequentially through the area**. |

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **d) Prevalence of trees and woodland of varying character** | |
| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
| **Woodland and trees** form a key characteristic of the Nithsdale landscape. These vary from riparian woodland, to small clusters of trees around houses and settlements within the valley floor, rising up to predominantly native woodland and conifer plantations over the upper hill slopes. Trees and woodland reinforce the distinctive landscape pattern in many areas, sometimes as part of policy woodland upon estates, such as at Drumlanrig, and often provide the framework for agricultural holdings. They also **define spaces, create edges that offer shelter**, and contribute to **a sense of refuge and tranquillity** within enclosed spaces. Within these areas, there is often a **focus upon the intricacies of foreground details**, sounds and smells, | The Dalswinton windfarm **varies in its relationship to woodland and trees** through the Nithsdale landscape. From elevated areas, it tends to be seen in association with the **large upland conifer plantations with which it relates in scale and obvious human management**; however, from lower-lying areas, it often forms a more **confusing image in combination with fore and midground woodland, hedgerows and policy trees**. This is partly because of the variable screening of the wind turbines, but also because they tend to appear more imposing in their scale and blade rotation in relation to smaller, sheltered spaces. |

Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm

**d) Prevalence of trees and woodland of varying character**

| ***Key characteristics and qualities and how these are experienced and valued*** | ***Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued*** |
|---|---|
| facilitated by the exclusion of outside distractions. |   |
| **Woodland and trees have varying screening effect as people move through the Nithsdale landscape** - screening some distant views, but also framing others so that distant and/ or elevated features can be highlighted. **Perception of the layout and pattern of woodland and trees** typically relates to the elevation and distance of the viewer: From the valley floor, woodland and trees often screen low-lying views, so that it is difficult to perceive the distance and relative height of upland areas seen above and beyond; in contrast, from elevated views, the landscape pattern formed by trees and woodland can provide reference points that help the viewer to perceive relative distance and vertical scale.<br> *Two-sided framing*<br> *Three-sided framing to focus on distant view*<br> *Elevated views of woodland* | On account of the different screening effects of woodland within Nithsdale, the Dalswinton wind turbines are sometimes seen **framed by trees within the fore or midground**, **which heightens their prominence**. In contrast, where seen **beyond a wooded skyline, they are often less obvious,** due to the reduced contrast of shape to a 'jagged' skyline, although their **form and scale in these locations tends to appear more confusing.** This is partly because the wind turbine bases cannot be seen, nor the intervening ground, in order to be able to perceive their distance or size, meaning the **windfarm can appear much closer than it actually is and thus more imposing**. In addition, tree cover can affect the visible relationship between the windfarm and the landform, as described for the backcloth hills (b). |

<table>
<tr><td colspan="2">Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm</td></tr>
<tr><td colspan="2">d) Prevalence of trees and woodland of varying character</td></tr>
<tr><td>Key characteristics and qualities and how these are experienced and valued</td><td>Effects of the existing windfarm upon the characteristics and qualities and how these are experienced and valued</td></tr>
<tr><td>  <br>Woodland clothes slopes, so it is difficult to perceive distance and identify the nature of the hill top, eg whether a ridge or extending further as a plateau<br>Trees and woodland within elevated view helps distance perception</td><td>  <br>Framing of views increases prominence of windfarm<br>The prominence of the wind turbines is diminished where seen upon a wooded skyline; however, not seeing any underlying distance cues, these may seem closer than they actually are</td></tr>
<tr><td></td><td>While it is often expected that trees may act a scale reference for wind turbines, they tend to be so disparate in size to the Dalswinton wind turbines that it is very difficult to scale these in direct comparison, particularly in relation to wooded slopes over which only the canopy cover can be seen and thus it is difficult to perceive the height and extent of individual trees underneath.<br></td></tr>
</table>

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **e) Varying experience and vantage points across the Nithsdale landscape** | |
| ***Key characteristics and how these are experienced*** | ***Effects of the existing windfarm upon characteristic and how these are experienced*** |
| The varied topography and landscape pattern that contributes to the mixed landscape composition (described for a above) offers **various vantage points through the landscape of different elevation, orientation and exposure**. The dispersal of roads and settlement throughout the area also means that it is a landscape that tends to be **experienced everyday by many**.<br><br>Approaching Nithsdale from the west, north or east, there is a **distinct sequence of arrival, passing over the elevated edges of the backcloth hills** (b) that offer open views over the distinct landscape composition (discussed in a), before dropping down into the valley that is of greater intricacy and diversity of scale and pattern. **Views at different elevations provide different perspectives of the relationship between the landscape pattern and landform**.<br><br>Within the valley floor, views tend to be limited by fore and midground features and **focus upon local foci**, such as the River Nith, isolated houses and farm buildings and woodland blocks. **Occasionally, however, where there is an opening, views pass up to the hill skyline**, focussing on key landmarks such as hill forts. The sense of enclosure varies in relation to the presence or absence of vertical elements such as trees and buildings, and the edges created by them, while the distinctive field boundaries can create a rhythmic pattern while moving through the landscape.<br><br>**From the base of the backcloth hills and upon their lower slopes, visibility of the hill tops tends to be screened by the convex landform** (often amplified even greater by woodland or trees), with no clear indication of the extent of visibility, confused furthermore by the effects | The Dalswinton windfarm is **seen from many different vantage points within the surrounding landscape that vary in character**. In this way, it is viewed within different landscape contexts; however, because of its fairly compact and isolated form and distinct relationship to the adjacent Nith valley and Dumfries, it tends to be **clearly recognisable as a distinct feature**.<br><br>Given the distinct sequence of approach to Nithsdale from the west, north or east, the first view that many people gain of the Dalswinton windfarm is from an elevated viewpoint from a distance. In this way, it tends to be seen in its entirety and within a wide landscape setting before the traveller drops down into **the valley floor where views of the development are often partially screened and/ or intermittent**. This distinct sequence can allow people to use their memory of clearer views from a distance to interpret more confusing images when closer, although this depends on them identifying the windfarm as the same scheme.<br><br>**Different perspectives of the windfarm occur in relation to views of the landform and landscape pattern**, as shown in the diagrams below: From the footslopes of the hill backcloth (i), there is limited and partial visibility of the wind turbines up above, and these appear imposing due to the visible combined elevation of the hill and the wind turbines; from the opposite side of the valley floor (ii), there are clearer views of the wind turbines, especially where the valley floor is open, and the form and location of the wind turbines is easier to discern; and iii) from opposite hills, it is very clear to see both the composition of the whole windfarm and its wider landscape context, as well as being able to perceive its far distance based on scale markers provided by intervening features of the landscape pattern below; from these areas, given |

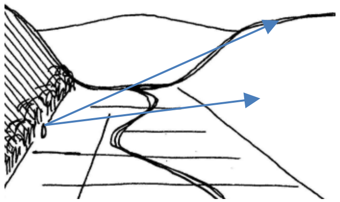
Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm

<table>
<tr><th colspan="2">e) Varying experience and vantage points across the Nithsdale landscape</th></tr>
<tr><th>Key characteristics and how these are experienced</th><th>Effects of the existing windfarm upon characteristic and how these are experienced</th></tr>
<tr><td>

of visual foreshortening when looking up from lower elevations.

*Hill top and profile clearer to see from a distance than from the base of the slopes.*

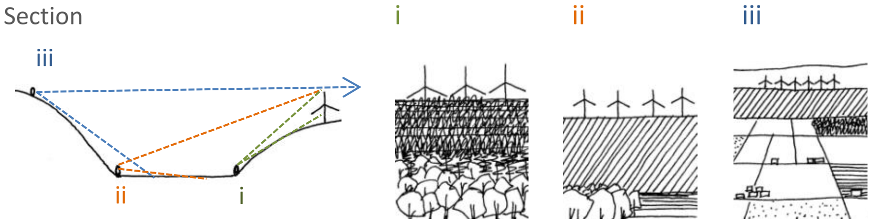
Because of the limited visibility upslope, key **views from the base of the backcloth hills tend to be across the valley floor to opposite hill slopes**, resulting in **strong qualities of prospect**, especially where shielded by woodland behind. It is also within these views that the profile and pattern of the hills opposite tends to be most clear as they appear beyond an area of open space.



**From the backcloth hill slopes, views often focus upon the skyline of the hills opposite and up into the sky.** This is not just because the skyline

</td><td>

the perceived distance, minor scale and lower elevation, the windfarm tends to appear more ‘subservient’ within its surroundings. Given this relationship between visibility, distance and landform, contrary to many people’s expectations, **visibility and prominence of the windfarm often increases with greater distance** from the development. In addition, it means that the **windfarm is often seen in surprise** from distant viewpoints, suddenly ‘appearing’ as one turns a corner, although it may have been not visible from closer locations.

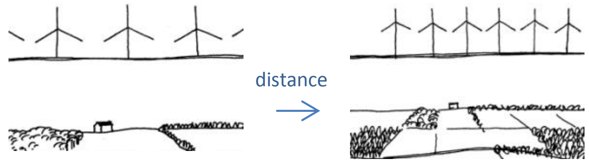
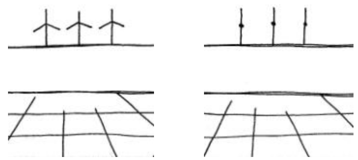



*Different perspective of windfarm in relation to visibility of the landform and landscape pattern*

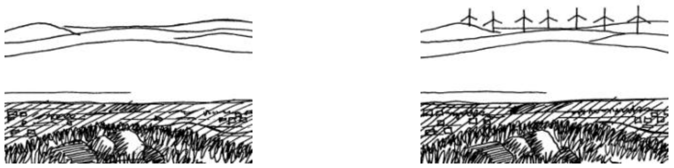
In addition to increased prominence, the **scale of the Dalswinton windfarm often seems to increase with distance,** as more wind turbines are revealed when no longer screened by the intervening convex landform horizon and fore and midground woodland.

From the Nith valley, the collective ridge of the backcloth hills (as discussed previously in b) often screens the lower part of the towers of the Dalswinton

</td></tr>
</table>

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **e) Varying experience and vantage points across the Nithsdale landscape** | |
| ***Key characteristics and how these are experienced*** | ***Effects of the existing windfarm upon characteristic and how these are experienced*** |
| forms a distinctive feature in its own right (see b), but also because the sky forms a greater proportion of the field of view from higher elevations. This means attention tends to be drawn to changing sky conditions due to weather and time of day, particularly at sunset and sunrise or where spots of sunshine highlight features against a dark sky. | wind turbines. However, because of the particular layout of the windfarm in relation to the landform, it is **often not clear that the towers are partially screened**; this is partly because the wind turbines tend to be visible by the same degree, whereas if some were seen in totality it would highlight that others were screened. A consequence of this effect is that, **as the viewer gets further from the backcloth hills, the wind turbines tend to appear to get taller** as a greater proportion of their towers become visible.<br><br>*An undulating landform horizon allows the visibility of some wind turbines to inform the perception of others' scale*<br><br><br>*A largely horizontal ridge tends to mean the degree of screening of wind turbine towers is consistent and thus the wind turbine towers seem to gradually get longer with increased distance and reduced landform screening.*<br>From some directions (usually the south east and north west), the Dalswinton **wind turbines are seen mainly 'side on'**, due to the prevailing wind which they face blowing at right angles to the viewing direction. From these areas, although less of the wind turbines can be seen, contrary to what<br><br>*Difference of vertical emphasis of wind turbines depending on whether they are seen 'face on' or 'side on'* |

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **e) Varying experience and vantage points across the Nithsdale landscape** | |
| ***Key characteristics and how these are experienced*** | ***Effects of the existing windfarm upon characteristic and how these are experienced*** |
| | might be expected, the wind turbines may have greater visual effects because they have **greater vertical emphasis,** as their blades and tower seem to form one vertical element, rather than their form also including diagonal/ horizontal elements. |
| In contrast to views from the valley floor and lower slopes, **the larger hills, plateaux and moorland offer wide panoramic views**. These are gained not only from the hill peaks, but also from the 'front' edges of ridges that surround Nithsdale. From these locations, there is **greater 'legibility' of the landscape, including its distinct pattern -** partly due to elevation, but also because of reduced screening from the landform and trees.  Within these elevated views, it is also possible to see the wider context of the area, including the Solway Firth to the south and the large scale hill interior (see c above). As described previously in section a, **large scale landmarks are important in defining places** within this broad composition and include the distinctive hill profiles of Criffel and Queensberry, the Wether Hill windfarm, several masts and the 'golf ball' radar station upon Lowther Hill. | From the larger hills, plateaux and moorland, the **Dalswinton windfarm tends to appear as just one feature within a complex composition seen within wide panoramic views** over Nithsdale. Near to the windfarm itself, views from the 'front' edges of the backcloth hills tend to be directed in the opposite direction and, for this reason, the windfarm mainly distracts attention at a local level. Conversely, however, **from distant high hills and plateaux on the other sides of Nithsdale, the Dalswinton windfarm is seen as a prominent focal feature, standing out in its elevated position and contrast of pattern and form** (varying to the typical location of human elements within the valley or upon the lower slopes).<br><br>Located upon the backcloth hills (see b above), the **Dalswinton windfarm does not seem to encroach directly upon the valley floor below**; **neither does it tend to visually compete with other large scale landmarks** due to its separation from these. Nonetheless, it does **form a prominent focus within views from elevated hill tops** and, because of its elevation, can appear to **undermine the landform and the viewer's sense of being 'on top of the world'**. This perception tends to be amplified if the windfarm appears as the highest element within views and/or higher than the viewer even though they have made great efforts and taken a long time and distance to ascend the hill |

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **e) Varying experience and vantage points across the Nithsdale landscape** | |
| ***Key characteristics and how these are experienced*** | ***Effects of the existing windfarm upon characteristic and how these are experienced*** |
| From the elevated hill tops, **seeing far into the distance** and with **strong qualities of exposure**, there is a sense of being **'on top of the World'**. This perception is reinforced by seeing **successive tiers of high hill horizons that seem to recede infinitely into the distance**. In addition, it is emphasised by the ascent of these areas along narrow roads that typically wind back and forth with tight cross-backs, emphasising the steepness and elevation of the hills. The experience of these areas is, however, strongly affected by the **presence of existing human elements**, such as forest plantations, which diminish the sense of exposure and naturalness. | slopes. Even if seen at similar elevation to a viewer, the windfarm can appear overbearing, especially where it seems 'confrontational' by appearing opposite a key prospect view.<br><br>*The sense of being elevated and 'on top of the world' can seem diminished if the windfarm is seen at a higher or similar elevation to the viewer, particularly if great effort, time or distance has been taken to ascend the vantage point. The development can also seem more imposing if seen directly opposite key prospect views.* |
| **Most local people within Nithsdale tend to reside and travel within and along the valley floor and lower slopes** and thus these are the areas from which they mostly experience the surrounding landscape. For recreation, both **local residents and visitors tend to experience the landscape in a fairly 'low key' manner**, for example cycling, horse-riding and walking along local minor roads and tracks, canoeing and fishing upon the rivers, and walking within some of the woodlands.<br>Local people and visitors also visit the surrounding hills via the high passes between Nithsdale and neighbouring valleys, sometimes as part of a circular motoring route (eg Dumfries – Ae – Thornhill – | <br>Most people tend to see the Dalswinton windfarm as they are **moving through the local landscape – both during their everyday activities and for recreation**, and particularly from the edges of Dumfries and Thornhill, along the A76 main road through Nithsdale, and from local villages and the surrounding agricultural area.<br>As discussed in b and d above, the windfarm tends to be **seen partially and/or intermittently when moving through these areas** due to the screening effect |

| Table F.1.1: Key landscape and visual characteristics, qualities and the experience of these within case study A and the effects upon these of the existing Dalswinton windfarm | |
|---|---|
| **e) Varying experience and vantage points across the Nithsdale landscape** | |
| ***Key characteristics and how these are experienced*** | ***Effects of the existing windfarm upon characteristic and how these are experienced*** |
| Dumfries), as well as walking and cycling along estate and forest tracks and paths. Many people also take walks to local historic features, such as Morton Castle, in addition to larger landmark hills, for example Queensberry, The Mull and Criffel.  There are some **recreation facilities that attract not only local people, but also visitors from further afield**, for example the Sustrans regional cycle route 10 and the Kirkpatrick Macmillan Trail cycle route, trails at Drumlanrig Castle, the Southern Upland Way long distance route, the sculptures in Glenkiln and Andy Goldsworthy Striding Arches, and the 7stanes cycle trails at Mabie and Ae.  For some, it is the activity, rather than the landscape, that is the main focus of these attractions/routes, particularly where located within dense forest plantations; however, the **character of the landscape contributes without doubt to the quality of the experience of these attractions/ routes**, particularly from elevated locations and/or where there are open views, within designed landscapes, or where a strong sense of tranquillity and/or remoteness is sought. | of local landscape features. In this context, the windfarm tends to appear **sufficiently separated from most people within the area to avoid it seeming to impose directly upon their enjoyment of the landscape**; however it does form **a very prominent feature within the area**, particularly where seen within framed views. In addition, the rotation of the wind turbine blades and/ or the noise of these **can disturb people who are seeking a sense of tranquillity within the local landscape**. As part of people's 'everyday landscape' the **initial surprise of seeing Dalswinton windfarm diminishes over time**; **nonetheless, it's prominence continues**, as **the wind turbines appear different each day** in different weather and light conditions. Indeed, for some people, it is **a reference feature that they look for regularly** to indicate environmental conditions. In addition, the variable visibility and/or partial screening of the windfarm can mean that it is **encountered from some unexpected locations in certain conditions**, including at a distance (eg the A75 at Crocketford), meaning it continues to draw attention by the unpredictability of visual effects.  *Varying appearance of Dalswinton windfarm in different weather and light conditions* |

# APPENDIX G

## *Chapter 7: Public Attitude and Preference Study*

## Appendix G.1: Questionnaire to understand the words people use to describe scale effects

Table G.1.1: Age categories for questionnaire respondents and general Scottish population

| Age | No of respondents | % respondents | Scottish population from census 2011- % |
|---|---|---|---|
| 16-30 | 2 | 3 | 24 |
| 31-45 | 14 | 19 | 24 |
| 46-60 | 26 | 35 | 25 |
| >60 | 32 | 43 | 27 |
| **Total** | **74*** | **100** | **100** |

*One respondent did not respond to this specific question

Table G.1.2: Occupation categories for questionnaire respondents and general Scottish population

| Occupation | No of respondents | % respondents | Scottish population from census 2011- % |
|---|---|---|---|
| Likely informed about landscape and the effects of windfarm scale | 49 | 66.22 | 10.47 |
| Not informed or unsure how informed about landscape and the effects of windfarm scale | 25 | 33.78 | 89.53 |
| **Total** | **74*** | **100.00** | **100.00** |

*One respondent did not respond to this specific question

Table G.1.3: Number of windfarms seen by questionnaire respondents

| Number of windfarms seen in last 5 years | No of respondents | % |
|---|---|---|
| 1-5 | 8 | 11 |
| 6-10 | 15 | 20 |
| 11-15 | 10 | 13 |
| >15 | 41 | 55 |
| Not stated | 1 | 1 |
| **Total** | **75** | **100** |

| Table G.1.4: Categorised attitudes to wind energy development based on options selected by questionnaire respondents | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Option no. | Attitude | Choice 1 | Choice 2 | Choice 3 | Total *n* | Types *n* | *Types %* |
| Mostly positive towards windfarms | 1 | Wind turbines can make a useful contribution to renewable energy generation and are a positive way forward | 24 | | | 24 | 32 | 24.8 |
| | 3 | Wind turbines are generally appropriate within Scottish landscapes | | 2 | | 2 | | |
| | 8 | Other mainly positive | 1 | 1 | 4 | 6 | | |
| Mostly negative towards windfarms | 2 | Wind turbines are inefficient and contribute little to energy generation | 22 | | | 22 | 39 | 30.2 |
| | 5 | Wind turbines are generally inappropriate within Scottish landscapes | 4 | 10 | | 14 | | |
| | 8 | Other mainly negative | 2 | | 1 | 3 | | |
| Attitude depends on location and siting of windfarm | 4 | Wind turbines are suited to some Scottish landscapes, depending on their location and design | 20 | 22 | 2 | 44 | 58 | 45.0 |
| | 6 | Wind turbines are more appropriate located offshore | 1 | 7 | 6 | 14 | | |
| | 7 | Not sure | | | | 0 | 0 | 0 |
| | | | | | **Total** | **129** | **129** | **100.0** |

Table G.1.5: Alternative words suggested by questionnaire respondents for description of scale effect

| Words suggested (in alphabetical order) | Low scale effect images | | | Medium scale effect images | | | High scale effect images | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | **1** | **4** | **8** | **6** | **3** | **7** | **2** | **5** | **9** | |
| acceptable | 2 | 1 | 1 | | | 1 | | | | 5 |
| aggressive | | | | | | | | | 1 | 1 |
| appropriate | 2 | | | | | | | 1 | | 3 |
| associates | | 1 | | | | | | | | 1 |
| blot on the landscape | | | | | | | 2 | | 2 | 4 |
| busy | | | | | 1 | | | | | 1 |
| calming | | | | | 1 | | | | | 1 |
| camouflaged | | | | | | 1 | | | | 1 |
| carbuncle | | | | | | | | 1 | | 1 |
| chaotic | | | | | | | | 1 | | 1 |
| cluttered | | | | | | | | 1 | | 1 |
| coherent | | | | 1 | | | | | | 1 |
| contained | | 1 | | | | | | | | 1 |
| desecration | | | | | | | | 1 | | 1 |
| discompose the skyline | | | | | | 1 | | | | 1 |
| discordant | | | 1 | | | | | | | 1 |
| disfigure the land | | | | | | | | | 1 | 1 |
| encircling | | | | | | 1 | | | | 1 |
| excessive | | | | | | | 1 | | | 1 |
| extensive | | | | | | 1 | | 1 | | 2 |
| eyesore | 1 | | | 1 | | | | 1 | | 3 |
| fairly acceptable | | | | | 1 | 1 | | | | 2 |
| focal feature | | 1 | | | | | | | | 1 |
| giant | | | | | 1 | | | | | 1 |
| hideous | | 1 | | | | | | | | 1 |
| high impact | | | | | | | | 1 | | 1 |
| ill-planned | | | | | 1 | | | | | 1 |
| impact high | | | | | | | 1 | | | 1 |
| inappropriate | 1 | 2 | 2 | | 1 | | 1 | | 1 | 8 |
| incongruous | | | | 1 | | | | | | 1 |
| In context | 1 | | | | | | | | | 1 |
| Industrial, industrialisation | | | | 1 | | | | 2 | | 3 |
| inoffensive | 1 | | | | 1 | 1 | | | | 3 |
| intrusive | 2 | | 1 | 1 | | | | | 1 | 5 |
| irrational | | | 1 | | | | | | | 1 |
| majestic | | | | | | | | 1 | | 1 |

| Table G.1.5: Alternative words suggested by questionnaire respondents for description of scale effect | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Words suggested (in alphabetical order) | Low scale effect images | | | Medium scale effect images | | | High scale effect images | | | Total |
| | **1** | **4** | **8** | **6** | **3** | **7** | **2** | **5** | **9** | |
| monsters, monstrosities, monstrous | | | | | 1 | | 1 | 1 | | 3 |
| not imposing | 1 | | | | | | | | | 1 |
| not in my back yard | 1 | | | | | | | | | 1 |
| obtrusive | 1 | | | 1 | | | | | | 2 |
| out there | | | | | | 1 | | | | 1 |
| overtaking the environment | | | | | | | | 1 | | 1 |
| polluting effect | | | | | | | | 1 | | 1 |
| probably inefficient | | 1 | | | | | | | | 1 |
| prominent | 1 | 1 | | 1 | | 2 | 1 | | 1 | 7 |
| rational | | | | | | | | 1 | | 1 |
| scattered | | | | | 1 | | | | | 1 |
| 'spoilation' | 1 | | | | | | | | | 1 |
| spoils the view | | | | | 1 | | | | | 1 |
| strange | | | | | | 1 | | | | 1 |
| threatening | | | | | | | 1 | | 1 | 2 |
| too big | | | | | 1 | | | | | 1 |
| totally inappropriate | | | | | | | | 1 | | 1 |
| ugly | | | 1 | | | | 1 | | | 2 |
| unnatural | | 1 | | 1 | | | 1 | | | 3 |
| unbalanced | | | 1 | 1 | | | | | | 2 |
| ungainly | | | | | | | 1 | | | 1 |
| 'uniformal' | | | | | | | 1 | | | 1 |
| unlimited disaster | | | | 1 | | | | | | 1 |
| unsightly | | | | | 1 | | | | | 1 |
| unutterable | | 1 | | | | | | | | 1 |
| vile | | | | | | 1 | | | | 1 |
| well-placed | | 1 | | | | | | | | 1 |

## Appendix G.2: Adaptive Choice-Based Conjoint (ACBC) analysis

### G.2.1: Analysis of the differences between the average importances for windfarm proximity, windfarm size and wind turbine size

*Friedman Test*

**Ranks**

| | Mean Rank |
|---|---|
| Proximity of windfarm | 2.21 |
| Windfarm size | 1.95 |
| Size of wind turbine | 1.84 |

**Test Statistics[a]**

| | |
|---|---|
| N | 117 |
| Chi-Square | 8.735 |
| df | 2 |
| Asymp. Sig. | .013 |

a. Friedman Test

*Wilcoxon Signed Ranks Test*

**Test Statistics[a]**

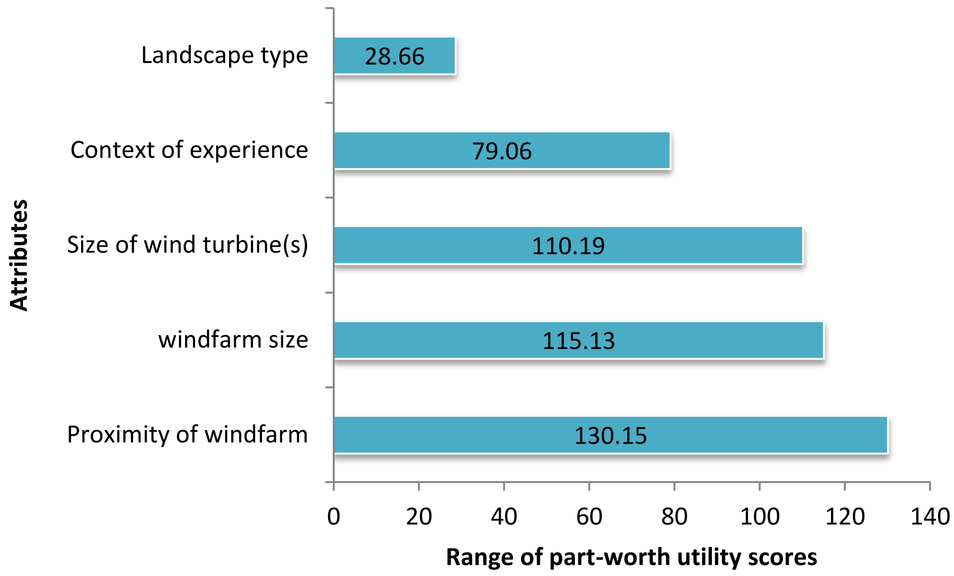
| | Windfarm size – Proximity of windfarm | Size of wind turbine – Proximity of windfarm | Size of wind turbine – Windfarm size |
|---|---|---|---|
| Z | -2.112[b] | -3.379[b] | -.828[b] |
| Asymp. Sig. (2-tailed) | .035 | .001 | .408 |

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

### G.2.2: Ranges for the average importances for the attributes

Analysis of the range of importances for the attributes is shown in the bar graph overleaf, revealing how average importance scores differ between the lowest and highest levels. For example, a change of wind turbine from being large-sized (that has an average part-worth utility value of 52.26) to small-sized (that has an average part-worth utility score of -57.93) results in a wide range of importance of 110.19; in contrast, there is a much smaller range of difference of 37.41 between the highest part-worth utility score for landscape type (seeing a windfarm within an agricultural and settled landscape, 10.04) and the lowest part-worth utility score (seen in a wooded landscape, -18.62).




**G.2.3: Non-parametric tests to assess differences of importances of respondents in relation to occupation**

Non-parametric test using Friedman and Wilcoxon to examine the difference between the average importances of the proximity, windfarm size and wind turbine size attributes for respondents with different occupation

*Friedman Test - Informed Occupation*

**Ranks**

| | Mean Rank |
|---|---|
| Size of wind turbine | 1.75 |
| Proximity of windfarm | 2.52 |
| Windfarm size | 1.73 |

**Test Statistics[a]**

| | |
|---|---|
| N | 77 |
| Chi-Square | 31.195 |
| df | 2 |
| Asymp. Sig. | .000 |

a. Friedman Test

*Wilcoxon signed ranks test – Informed Occupation*

**Test Statistics[a]**

| | Proximity of windfarm – Size of wind turbine | Windfarm size – Size of wind turbine | Windfarm size – Proximity of windfarm |
|---|---|---|---|
| Z | -4.360[b] | -.332[c] | -3.610[c] |
| Asymp. Sig. (2-tailed) | .000 | .740 | .000 |

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.

*Friedman Test - Uninformed Occupation*

**Ranks**

| | Mean Rank |
|---|---|
| Size of wind turbine | 1.89 |
| Proximity of windfarm | 1.93 |
| Windfarm size | 2.17 |

**Test Statistics[a]**

| | |
|---|---|
| N | 46 |
| Chi-Square | 2.130 |
| df | 2 |
| Asymp. Sig. | .345 |

a. Friedman Test

*Wilcoxon signed ranks test – uninformed Occupation*

**Test Statistics[a]**

| | Proximity of windfarm – Size of wind turbine | Windfarm size – Size of wind turbine | Windfarm size – Proximity of windfarm |
|---|---|---|---|
| Z | -.224[b] | -1.480[b] | -1.229[b] |
| Asymp. Sig. (2-tailed) | .823 | .139 | .219 |

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

## G.2.4: Non-parametric tests to assess differences of importances of respondents in relation to their attitudes to wind energy development

Non-parametric test using Friedman and Wilcoxon to examine the difference between the average importances of the proximity, windfarm size and wind turbine size attributes for respondents with different attitudes

*Friedman test – positive attitude*

**Ranks**

| | Mean Rank |
|---|---|
| Size of wind turbine | 1.75 |
| Proximity of windfarm | 2.52 |
| Windfarm size | 1.73 |

**Test Statistics**[a]

| | |
|---|---|
| N | 77 |
| Chi-Square | 31.195 |
| df | 2 |
| Asymp. Sig. | .000 |

a. Friedman Test

*Wilcoxon signed ranks test – positive attitude*

**Test Statistics**[a]

| | Proximity of windfarm – Size of wind turbine | Windfarm size – Size of wind turbine | Windfarm size – Proximity of windfarm |
|---|---|---|---|
| Z | -5.146[b] | -.333[c] | -4.618[c] |
| Asymp. Sig. (2-tailed) | .000 | .739 | .000 |

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.

*Friedman test – negative attitude*

**Ranks**

| | Mean Rank |
|---|---|
| Size of wind turbine | 2.00 |
| Proximity of windfarm | 1.63 |
| Windfarm size | 2.38 |

**Test Statistics**[a]

| | |
|---|---|
| N | 40 |
| Chi-Square | 11.250 |
| df | 2 |
| Asymp. Sig. | .004 |

a. Friedman Test

*Wilcoxon signed ranks test – negative attitude*

**Test Statistics[a]**

| | Proximity of windfarm – Size of wind turbine | Windfarm size – Size of wind turbine | Windfarm size – Proximity of windfarm |
|---|---|---|---|
| Z | -1.492[b] | -1.774[c] | -3.065[c] |
| Asymp. Sig. (2-tailed) | .136 | .076 | .002 |

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

## G.2.5: The relationship between attitude and occupation of respondents

The following is a custom table to examine the relationship between attitude and occupation of respondents.

| | | Occupation | |
|---|---|---|---|
| | | 1 | 2 |
| | | Count | Count |
| Attitudes1 | 1 | 56 | 21 |
| | 2 | 15 | 25 |

Attitude 1 = Positive or likely positive depending on location or proposal
Attitude 2 = Negative or likely negative irrespective of location or proposal
Occupation 1 = Likely informed about the landscape and the effects of windfarm scale
Occupation 2 = Not informed or unsure how informed about the landscape and the effects of windfarm scale

The following summarises the findings of a non-parametric test using Mann-Whitney to examine the relationship between occupation and attitudes

**Ranks**

| Attitudes1 | | N | Mean Rank | Sum of Ranks |
|---|---|---|---|---|
| Occupation | 1 | 77 | 51.95 | 4000.50 |
| | 2 | 40 | 72.56 | 2902.50 |
| | Total | 117 | | |

**Test Statistics[a]**

| | Occupation |
|---|---|
| Mann-Whitney U | 997.500 |
| Wilcoxon W | 4000.500 |
| Z | -3.684 |
| Asymp. Sig. (2-tailed) | .000 |

a. Grouping Variable:
Attitudes1

**G.2.6: The relationship between average importance of the attributes and number of windfarms seen previously**

Non-parametric test using Spearman's rho

| | | No. windfarms seen in Scotland |
|---|---|---|
| Context of experience | Correlation Coefficient | -.105 |
| | Sig. (2-tailed) | .259 |
| | N | 117 |
| Landscape type | Correlation Coefficient | .064 |
| | Sig. (2-tailed) | .496 |
| | N | 117 |
| Size of wind turbine | Correlation Coefficient | .121 |
| | Sig. (2-tailed) | .192 |
| | N | 117 |
| Proximity of windfarm | Correlation Coefficient | .098 |
| | Sig. (2-tailed) | .292 |
| | N | 117 |
| Windfarm size | Correlation Coefficient | .032 |
| | Sig. (2-tailed) | .735 |
| | N | 117 |

**G.2.7: Differences between the part-worth utility scores for the context of experience attribute**

Non-parametric test using Friedman and Wilcoxon to examine the difference between three of the average part-worth utilities for the context of experience attribute

*Friedman test*

**Ranks**

| | Mean Rank |
|---|---|
| Seen while on a local lowland walk | 2.09 |
| Seen from a local hilltop | 1.52 |
| Seen from a garden | 2.38 |

**Test Statistics[a]**

| | |
|---|---|
| N | 117 |
| Chi-Square | 45.145 |
| df | 2 |
| Asymp. Sig. | .000 |

a. Friedman Test

*Wilcoxon signed ranks test*

**Test Statistics**[a]

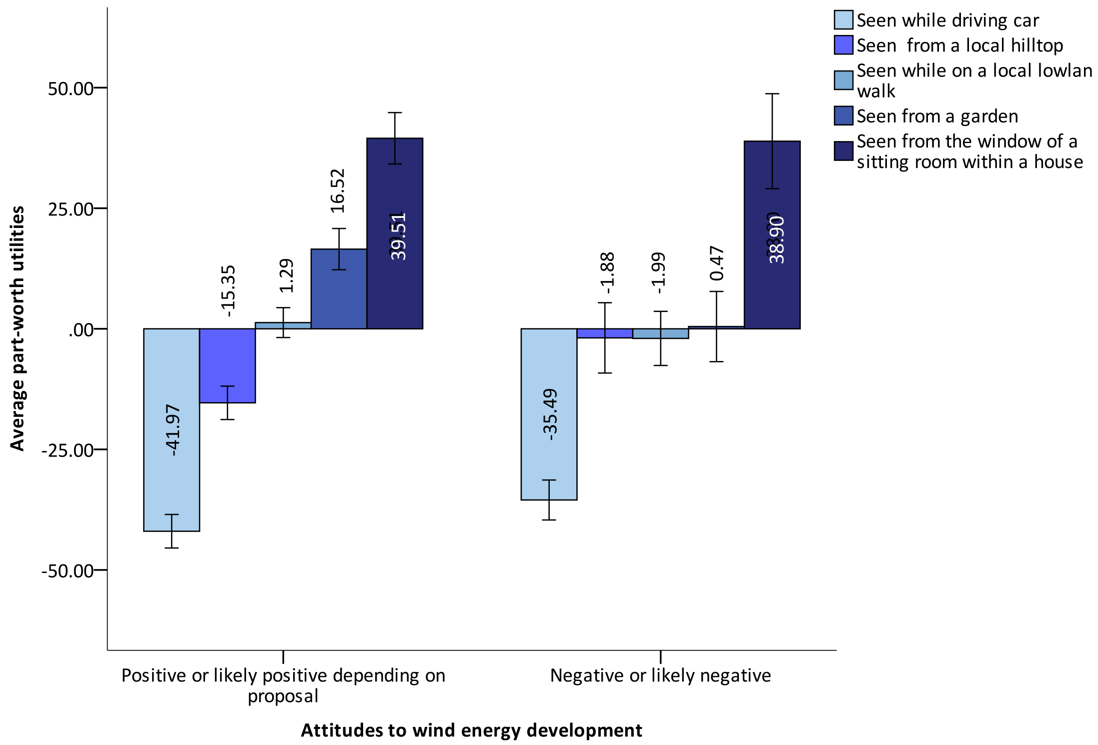
| | Seen while on a local lowland walk – Seen from a garden | Seen from a local hilltop – Seen while on a local lowland walk | Seen from a garden – Seen from a local hilltop |
|---|---|---|---|
| Z | -3.491[b] | -5.357[b] | -5.732[c] |
| Asymp. Sig. (2-tailed) | .000 | .000 | .000 |

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

## G.2.8: Differences between the part-worth utility scores for the context of experience attribute for people with different attitudes to wind energy development




| Friedman Test | Chi-Square | df | Asymp.Sig |
|---|---|---|---|
| Positive attitude | 73.039 | 2 | .000 |
| Negative attitude | .150 | 2 | .928 |

| Wilcoxon Signed Ranks Test | | Seen while on a local lowland walk – seen from a garden | Seen from a local hilltop – seen while on a local lowland walk | Seen from a garden – seen from a local hill top |
|---|---|---|---|---|
| Positive attitude | z | -4.308[b] | -6.598[b] | -6.649[c] |
| | Asymp.Sig.(2-tailed) | .000 | .000 | .000 |
| Negative attitude | z | -.094[b] | -.121[b] | -.336[b] |
| | Asymp.Sig.(2-tailed) | .925 | .904 | .737 |

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks.

## G.2.9: Differences between the part-worth utility scores for the landscape type attribute

Non-parametric test using Friedman and Wilcoxon to examine the difference between three of the average part-worth utilities for the landscape type attribute

*Friedman test*

**Ranks**

| | Mean Rank |
|---|---|
| Seen in an agricultural and settled landscape | 2.13 |
| Seen in a moorland landscape | 1.94 |
| Seen upon backcloth hills above a mixed landscape pattern | 1.93 |

**Test Statistics[a]**

| | |
|---|---|
| N | 117 |
| Chi-Square | 2.889 |
| df | 2 |
| Asymp. Sig. | .236 |

a. Friedman Test

*Wilcoxon signed ranks test*

**Test Statistics**[a]

| | Seen in a moorland landscape – Seen in an agricultural and settled landscape | Seen upon backcloth hills above a mixed landscape pattern – Seen in a moorland landscape | Seen upon backcloth hills above a mixed landscape pattern – Seen in an agricultural and settled landscape |
|---|---|---|---|
| Z | -1.356[b] | -.447[b] | -2.090[b] |
| Asymp. Sig. (2-tailed) | .175 | .655 | .037 |

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

## G.2.10: Correlation between average importances for windfarm attributes

Non-parametric test using Spearman's rho to examine correlation between average importances for windfarm attributes, cumulative extent of windfarms, and position and elevation of viewers

| | | Size of wind turbine | Proximity of windfarm | Windfarm size | Cumulative extent of windfarm | Relative position and elevation of viewer |
|---|---|---|---|---|---|---|
| Size of wind turbine | Correlation Coefficient | 1.000 | .258** | -.103 | -.121 | .083 |
| | Sig. (2-tailed) | | .005 | .268 | .192 | .371 |
| | N | 117 | 117 | 117 | 117 | 117 |
| Proximity of windfarm | Correlation Coefficient | .258** | 1.000 | .646** | -.416** | .270** |
| | Sig. (2-tailed) | .005 | | .000 | .000 | .003 |
| | N | 117 | 117 | 117 | 117 | 117 |
| Windfarm size | Correlation Coefficient | -.103 | .646** | 1.000 | -.263** | .158 |
| | Sig. (2-tailed) | .268 | .000 | | .004 | .090 |
| | N | 117 | 117 | 117 | 117 | 117 |
| Cumulative extent of windfarm | Correlation Coefficient | -.121 | -.416** | -.263** | 1.000 | -.078 |
| | Sig. (2-tailed) | .192 | .000 | .004 | | .402 |
| | N | 117 | 117 | 117 | 117 | 117 |
| Relative position and elevation of viewer | Correlation Coefficient | .083 | .270** | .158 | -.078 | 1.000 |
| | Sig. (2-tailed) | .371 | .003 | .090 | .402 | |
| | N | 117 | 117 | 117 | 117 | 117 |

## G.2.11: Differences between the part-worth utility scores for the windfarm attributes for respondents with either positive or negative attitudes to wind energy development

Non-parametric test using Friedman and Wilcoxon to examine the difference between the average importances for the three windfarm attributes for those with a positive attitude and those with a negative attitude

### Friedman Test – respondents with positive attitude

**Ranks**

| | Mean Rank |
|---|---|
| Size of wind turbine | 1.75 |
| Proximity of windfarm | 2.52 |
| Windfarm size | 1.73 |

**Test Statistics[a]**

| | |
|---|---|
| N | 77 |
| Chi-Square | 31.195 |
| df | 2 |
| Asymp. Sig. | .000 |

a. Friedman Test

### Wilcoxon signed ranks test – respondents with positive attitude

**Test Statistics[a]**

| | Proximity of windfarm – Size of wind turbine | Windfarm size – Size of wind turbine | Windfarm size – Proximity of windfarm |
|---|---|---|---|
| Z | -5.146[b] | -.333[c] | -4.618[c] |
| Asymp. Sig. (2-tailed) | .000 | .739 | .000 |

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

c. Based on positive ranks.

### Friedman Test – respondents with negative attitude

**Ranks**

| | Mean Rank |
|---|---|
| Size of wind turbine | 2.00 |
| Proximity of windfarm | 1.63 |
| Windfarm size | 2.38 |

**Test Statistics[a]**

| | |
|---|---|
| N | 40 |
| Chi-Square | 11.250 |
| Df | 2 |
| Asymp. Sig. | .004 |

**Wilcoxon signed ranks test – respondents with positive attitude**

**Test Statistics**[a]

| | Proximity of windfarm – Size of wind turbine | Windfarm size – Size of wind turbine | Windfarm size – Proximity of windfarm |
|---|---|---|---|
| Z | -1.492[b] | -1.774[c] | -3.065[c] |
| Asymp. Sig. (2-tailed) | .136 | .076 | .002 |

a. Wilcoxon Signed Ranks Test

b. Based on positive ranks.

c. Based on negative ranks.

## Appendix G.3: ACBC questionnaire Build Your Own (BYO) and screening

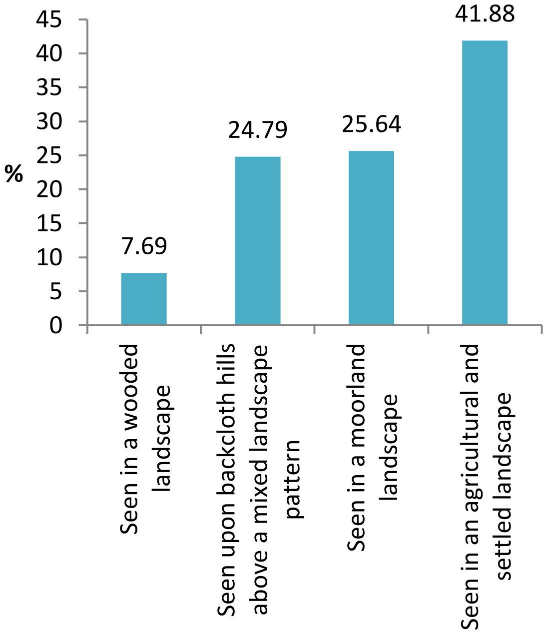



Figure G.3.1: From the BYO, percentage of landscape type levels selected to most likely result in an overbearing scale effect

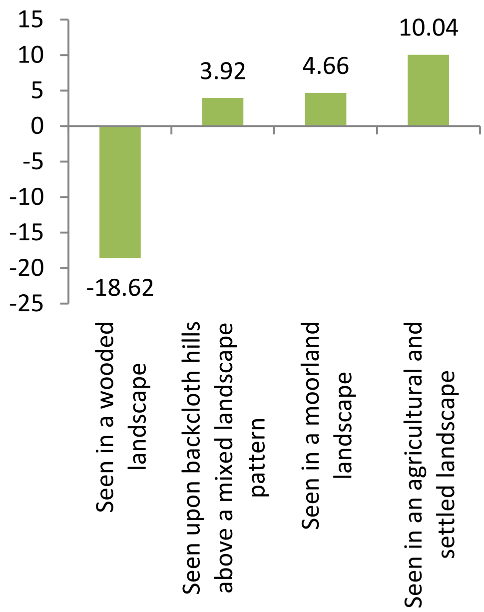



Figure G.3.2: From the choice-based questions, relative importances of the landscape type part-worth utility scores

| Table G.3.1: Attributes identified as a 'must have' for a windfarm to appear overbearing in scale | | |
|---|---|---|
| *Attribute* | *Level* | *No of responses* |
| Context of experience | Seen from a garden | 2 |
| | Seen from the window of a sitting room within a house | 1 |
| Landscape type | Seen in an agricultural and settled landscape | 1 |
| Size of wind turbine(s) | Large size | 1 |
| Proximity of windfarm | Nearby | 4 |

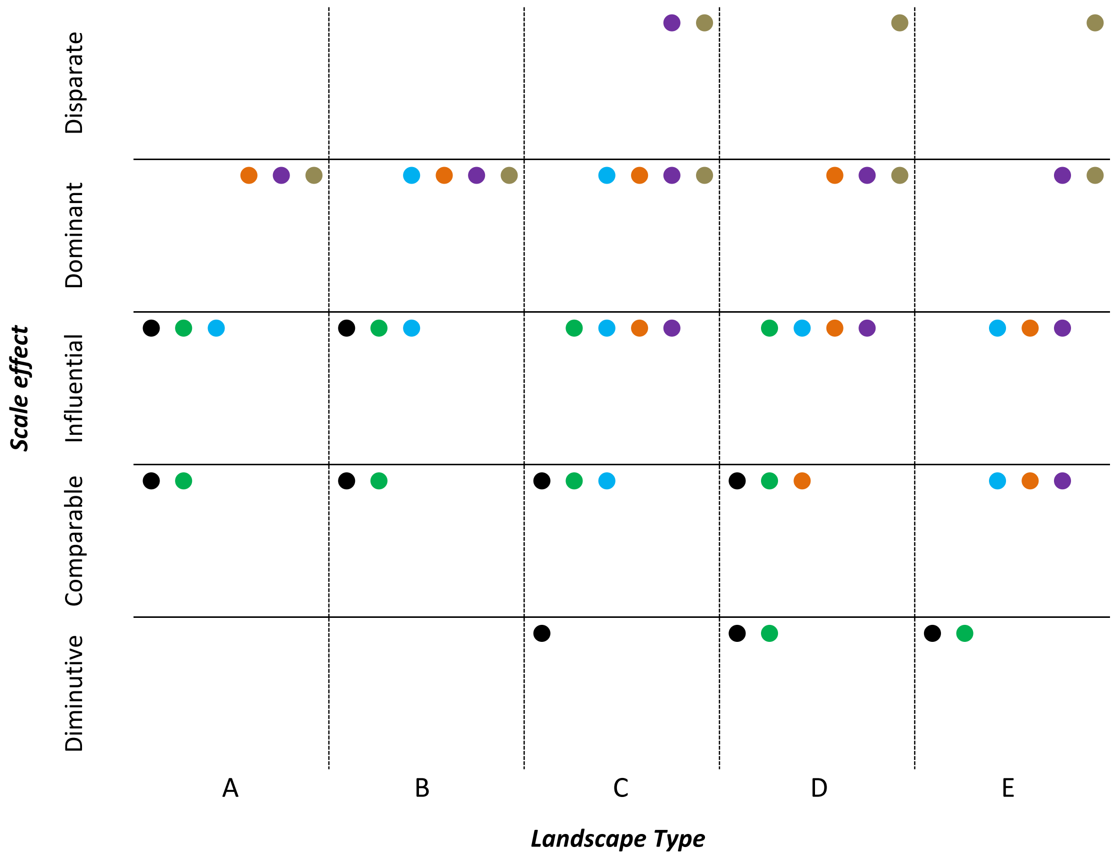
| Table G.3.2: Attributes identified as 'unacceptable', required to avoid a windfarm appearing overbearing in scale | | |
|---|---|---|
| *Attribute* | *Level* | *No of responses* |
| Context of experience | Seen while driving a car | 18 |
| | Seen while on a local, lowland walk | 5 |
| | Seen from a local hill-top | 10 |
| | Seen from a garden | 1 |
| | Seen from the window of a sitting room within a house | 2 |
| Landscape type | Seen in an agricultural and settled landscape | 1 |
| | Seen in a moorland landscape | 2 |
| | Seen in a wooded landscape | 6 |
| | Seen upon backcloth hills above a mixed landscape pattern | 6 |
| Size of wind turbine(s) | Small size wind turbine | 22 |
| | Up to medium size wind turbine | 3 |
| Proximity of windfarm | Nearby | 2 |
| | Up to middle distance | 6 |
| | Far distance | 40 |
| Windfarm size | Single wind turbine | 19 |
| | Up to large number of wind turbines | 2 |

# APPENDIX H

## *Chapter 8: Review of research findings, consideration of their application and conclusions*

## Appendix H.1: Early exploration of a possible relationship between landscape scale, windfarm scale and scale effects

***Potential scale effects of different wind turbine sizes within different landscape types***




**Potential wind turbine types:**

● 26-50m
● 51-75m
● 101 – 125m
● 76-100m
● 126 - 150m
● 151m – 175m

**Potential landscape types** (that have distinct scale effect)

A Small scale agricultural/ settlement/ woodland
B Medium scale dispersed/ concentrated settlement
C Medium scale agriculture/ forest
D Medium/ large scale moorland/ coast
E Medium/ large scale mountains/ hills

Figure H.1.1: Early 'mock up' research stage diagram exploring a possible relationship between different wind turbine size, different landscape type and different scale effects, and the thresholds occurring between these

## Appendix H.2: Limitations of the research

| Table H.2.1: Limitations of the research | |
|---|---|
| *Subject* | *Limitation and explanation* |
| Windfarm characteristics | **Range of windfarm types**<br>The research focused upon three-bladed wind turbines between 50 and 150m high to tip, although other sizes and forms were considered during the background research (including 2-bladed machines and ranging in height from 15m to 196m). The limitation on size and form of wind turbine was applied to limit the variables and because this range represented the type of wind turbines that were most commonly proposed within Scotland during the research period. In addition, there were multiple existing examples that could be assessed on site and which had/ were likely to have significant adverse scale effects in the landscape. |
| | **Colour of wind turbines**<br>The research focused upon wind turbines that were white, off-white or light grey in colour (described in 3.3). This was to limit the variables, but also because these represented the colours of wind turbines that were most commonly existing and proposed within Scotland during the research period and are expected to continue to be used[20]. |
| | **Sound of wind turbines**<br>The research did not include assessment of the sound of wind turbines (described in 3.3), although this may affect the experience of a windfarm in the landscape. This omission was because wind turbine sound is a technical and complex subject (varying for different wind turbines in different locations) outwith the discipline of landscape architecture and consideration of it in detail would have taken resources away from other parts of the research. |
| | **Wind turbine layout**<br>The research did not include assessment in detail of the influence of wind turbine layout on scale effects. As described in 3.3, the layout of wind turbines does influence scale effects and this was identified during early stages of the LVIA research method and considered during the experiential landscape assessments. Nonetheless, it was judged that windfarm layout would not be included as one of the main attributes of scale effect assessed in detail during the later stages of the research given that this had less influence on scale effects than other attributes and it was difficult to limit the variables given the infinite range of windfarm layouts possible in relation to different landscapes. |
| | **Wind turbine blade rotation**<br>The movement of wind turbine blades was found to influence perception of scale effect and the landscape experience, identified during early stages of the LVIA research method and the experiential landscape assessments. Nonetheless, it was excluded from later, more detailed stages of the research to limit the variables considered and because wind turbine movement is a technical and complex subject (varying for different wind turbine models in different locations) for which detailed assessment would have taken resources away from other parts of the research. |
| | |

[20] LUC and Mark Turnbull Associates, 2014.

| Table H.2.1: Limitations of the research | |
|---|---|
| *Subject* | *Limitation and explanation* |
| | **Cumulative effects**<br>The research considered the cumulative scale effects of multiple windfarms when these were encountered during the LVIA research and experiential landscape assessment. In addition, the ACBC questionnaire included some 'select' questions regarding cumulative scale effects outwith the 'choice tournament'. Nonetheless, the research could not consider in detail the influence of cumulative schemes, for example setting benchmarks for 'normality' of scale. This was because of the limited number of windfarms within the case study areas and because all the range of cumulative scenarios would have presented too many variables for this study. |
| Temporary environmental conditions | **Weather and light conditions**<br>Although the experience of scale effects of a windfarm vary in different weather and light conditions, it was not possible to consider scale effects across all the possible weather and light conditions (as described in 3.3). A broad range of weather and light conditions were observed during site assessment and were discussed by participants of the semi-structured interviews and are reported in the interim reports for the case studies, as per the example in Appendix F.1. Nonetheless, site assessment was limited to the conditions of late spring to early autumn during good visibility, with sunshine and clear skies or partial cloud. |
| LVIA | **Number of existing LVIA reports reviewed**<br>The number of LVIA reports reviewed was limited due to time constraints. Nonetheless, a high consistency of issues was raised by the reports, indicating that further examples may have not raised a large number of different issues. |
| | **Revised edition of GLVIA**<br>Part-way through this research, the Guidelines for Landscape and Visual Impact Assessment (GLVIA) publication was updated from a second edition (2002) to a third edition (2013). This meant that both editions had to be reviewed and analysed during this research: the second edition in relation to the case study windfarms, as this was the edition that had been applied for these; and the third edition in relation to the scope for assessment in the future of scale effects and the experience of the landscape using GLVIA. The latter was required specifically to address two of the research questions: how can we best assess the scale effects of windfarms in the landscape; and how can we best communicate scale effects to different people? Nonetheless, it would have been preferable if the LVIA reports reviewed had followed the same edition of GLVIA that would also be used in the future, so the link between past and future application could be more direct. |
| Experiential landscape assessment | **Separation of findings in relation to research processes**<br>For the experiential landscape assessment, the data from the semi-structured interviews were combined with the data from the researcher's site assessment and then analysed and classified. Reflecting later on the specific value of the separate methods of experiential landscape assessment applied, it was realised that it might have been useful to have also analysed the data from the semi-structured interviews separately from the researcher's site assessment to understand what each process brought independently. This separation of data and analysis could be carried out in the future. |
| Questionnaire respondents | **Representation of questionnaire respondents**<br>The demographic characteristics of the respondents to the questionnaire on |

| Table H.2.1: Limitations of the research | |
|---|---|
| *Subject* | *Limitation and explanation* |
| | the words people use to describe effects were not representative of the general Scottish population.<br><br>There were difficulties in directly comparing some of the demographic characteristics of the respondents within those listed in the most recent national census. Nonetheless, it was confirmed that the respondents were typically older than represented by the general population and likely to be more informed about windfarms and/or the landscape.<br><br>It was not expected that the participants of the ACBC study would be representative of the general Scottish population as the study was distributed to those with an interest in windfarms and/or the landscape. This was because of the particular demands of the questionnaire. |
| Case studies | **Range of landscape types for case studies**<br>The range of landscape types included within the research was limited to those that consultees highlighted at an early stage as being particularly relevant to scale effects. The selection of case studies was also limited to include similar landscape character types within each case study area, so that these could be cross-compared. The case studies did not include urban areas, high mountain areas or offshore locations. |
| | **Case study C: example of area with neither existing nor proposed windfarm**<br>It was difficult to find a good case study C: an area of Scotland with neither an existing or proposed windfarm (even after background research and enquiry with SNH and planning officers and a range of landscape architecture consultants). This was due to the widespread distribution of existing and proposed windfarms across Scotland outwith nationally designated areas. This meant that there were a number of compromises that had to be made with the selection of case study C (described in 3.2), including it being an island and popular with tourists.<br><br>It was more difficult to attract participants for the experiential landscape assessment for Case Study C, partly because there was a perceived low threat of landscape change (as there were no existing or proposed windfarms). |
| Questionnaire scoring | **Likert scale for the questionnaire to examine the words people use to describe scale effects**<br>When providing a score for the Likert scale, some respondents confused selecting ‘weak’ scores for the suitability of words to describe scale effects and selecting ‘weak’ scores as a judgement of the scale effects of a windfarm, as discussed in section 7.2. This meant that data from the Likert scale was not used in the data analyses apart from identifying positive choices for specific words. |
| Questionnaire demographic questions | **Categorisation of people’s attitudes and occupation**<br>The categories of people’s attitudes and occupations (as an indicator of being informed by the subject) were identified following the background research and pilot studies. Nonetheless, it was difficult to group some of these for the data analyses in relation to the research questions; for example to know whether somebody retired or employed in an unconnected profession would be informed about the scale effects of windfarms in the landscape, or to know whether somebody who thought windfarms would be best offshore was positive or negative in attitude to onshore windfarms. Consequently, on reflection, it would have been better to ask different questions for people’s |

| Table H.2.1: Limitations of the research | |
|---|---|
| *Subject* | *Limitation and explanation* |
| | attitudes and occupation that related more closely to how the data would be analysed in relation to the research questions. |
| ACBC | **Some scale effects were difficult to question within the format of the questionnaire**<br>Some scale effects were difficult to represent, for example sequential effects whilst travelling or as would be gained through panoramic views. Some data on these and similar aspects were nonetheless obtained through use of 'select questions' that were not part of the choice tournament of the ACBC (described in Appendix D.8).<br><br>Some of the wording for the questionnaire was awkward as the software is structured primarily for identifying a preferred product, rather than a negative effect. This meant there were some double-negatives within the wording for the adaptive screening 'must-haves' and 'unacceptables' which were not possible to avoid whilst following the standard set-up processes. |
| | **Number of attributes brought into the questionnaire**<br>Through development of the ACBC questionnaire, including pilot studies, the attributes taken into the questionnaire were limited in number. This was not because of a restriction of the software (although the attributes needed to meet strict criteria for inclusion as defined by Orme, 2010), but because it was judged that respondents only had a limited tolerance (mainly time, attention and 'thinking space') to answer a particular range and number of questions (explained in Appendix D.8). |
| | **Method of conjoint analysis**<br>The findings of the screening and Build-Your-Own (BYO) parts of the ACBC study were not highly useful given only two attributes were included within the BYO (because of the predictable ranking of the windfarm attribute part-worth utilities). Yet including these aspects meant that some of the wording for the questionnaire was difficult (for the 'must-haves' and 'unacceptables') and the screening exercise made the questionnaire more lengthy and onerous for participants. This means, on reflection, CBC may have been a more suitable method of Conjoint Analysis, although there were other advantages of the adaptive method, such as the tailoring of concepts and producing more robust data from fewer respondents. |
| Prompt list for assessment | **Testing of prompt lists**<br>Whilst considering interpretation and future application of the research findings, the researcher carried out consultation with a range of planning and landscape architect practitioners, windfarm developers and academics (some of whom had been consulted at the early stages of the research). Through discussion with these, it was identified that it might be useful to develop some prompt lists, including one for windfarm siting and design and for the assessment process for scale effects and the experience of the landscape. Provisional versions of these are included in Appendices H5, H6 and H7 (Tables H.5.1, H.6.1, H.7.1 and H.7.2). Given the preliminary status of these, they have not been tested for different windfarm proposals in different landscapes, or as used by different people: a process that would be useful to undertake in the future. |

## Appendix H.3: Description of other assessment method: 'residential visual amenity study'

There is a type of assessment that has grown in popularity over the duration of this research, commonly titled as a 'residential visual amenity study'. There has been confusion in the past about the relationship of these to LVIA, but GLVIA3 (p107 and p109) has now clarified that they should be considered as a separate assessment process. There is no standard method for residential visual amenity studies, so they vary in content and quality, but they are typically described as comprising an assessment of the visual effects of a proposed development on residents. On this basis, it might be predicted that this would satisfy some of the problems identified for this research with regards to inadequate assessment of the effects of a scheme on people's experience of the landscape. In contrast, however, residential visual amenity studies do not typically provide this information required, despite being promoted by some EIA consultants (SLR and Hoare Lea Acoustics, 2015). The main reasons why these studies do not usually assess well the experience of the landscape for residents is: one, they are typically based on a combination of desktop data analysis and site assessment from the nearest publically accessible location to a residence (which may be some distance away and from which the property may be screened); they do not involve consultation with the resident about how they experience the landscape within or around their residence, for example within different rooms of the house, from their garden or from walks they take from the house; and they do not consider how residents' experiences are influenced not just by the view from in front their house, but also when moving through the surrounding landscape. This contrasts to the findings of this research which revealed that local people are not just concerned about whether or not they might be able to see a windfarm from their house but, instead, the effects of a scheme on how they experience the landscape from their local area in different ways and for different purposes, as a composite of experiences and values.

## Appendix H.4: General application of the research findings in practice and policy

Whilst considering potential application of the research findings in practice, six issues were identified as being particularly important to emphasise given existing shortcomings in practice and policy with regards to the consideration of scale effects. These are described in Table H.4.1 below.

| Table H.4.1: General issues important to the assessment of scale in practice | |
|---|---|
| *Aspect* | *Description* |
| **Good communication** | Good communication is crucial and exchange of information needs to pass in all directions and between multiple parties: the assessor; members of the public, planning officers and other statutory consultees; and the decision-maker.<br><br>With regards to scale, it is particularly important to distinguish what type of scale is being described (visual or spatial, as described in 2.1) and also what scale reference is being made (in reference to a range, another element, or what is judged as normal). In addition, it is important to distinguish between what the scale is and the effect that this will have on receptors and, particularly, on people experiencing the scale effect.<br><br>Words are often the best way in which to communicate scale and scale effects within a landscape, but they need to be clear so that a good representation is provided. For some people, 'finding the right words' may require assistance, perhaps through the help of a facilitator, or with the provision of a prompt list or an example range of words describing different scale effects from which words can be selected. Glossaries and lexicons can also assist this process and are useful for clarification, but they alone are not sufficient to ensure clarity of communication, particularly as repeated reference to these can be cumbersome.<br><br>Good communication requires good understanding as well as good writing, verbal and/or illustration skills. Thus, for some, there will be a need to understand better how scale effects occur, before they can convey this information to others. This is relevant to both professionals and members of the public. Furthermore, good communication requires the ability to be able to draw out what is most important and having the confidence to relay this information.<br><br>To aid communication regarding scale, it may be useful to use visualisations, but it needs to be borne in mind that these have significant limitations if not viewed in comparison with actual views on site. |
| **Participatory consultation with local people** | A key finding of this research was that, whilst a professional landscape architect is able to draw out the key aspects of scale and scale effect within a landscape, it is only through consultation with local people (both professionals and the public) that it is possible to gain a full, in-depth understanding of the relative importance of these and how they are experienced and valued. As raised above, this highlights the importance of two-way communication and that consultation should not concern just provision of information, but also receipt of information. Bell, Gray and Haggett (2005) highlight that this requires trust between parties. |

| Table H.4.1: General issues important to the assessment of scale in practice | |
|---|---|
| *Aspect* | *Description* |
| | To gain the most from consultation, there is usually a need for facilitation, for example by providing tools to help people relay information with confidence (ie, not just asking them what they like or what they want). Most information may be gained through discussion or questions in a semi-structured format. During this process, it is important to bear in mind that different people communicate in different ways. For example, different people may use different words to describe the same effects, or the same words to describe different effects. It is thus always important to take measures to understand what people mean by what they are saying and to calibrate this with other responses. |
| **Assessing how a landscape is experienced** | It is essential to assess how a landscape is experienced by people in order to understand the sensitivity and potential effects of scale. Although some background information can be provided by sources such as designated area citations, LCAs or visitor websites, there is no substitute to comprehensive site assessment and consultation. This needs to include assessment of how, what and for why people experience the landscape. It also needs to take into account how the characteristics, qualities and experience of the landscape vary in different circumstances, for example at different times, during different weather, and via different modes of travel. |
| **Identifying what is important** | It is necessary to carry out comprehensive assessment to know what is important and to not limit the scope of an assessment to what an assessor thinks can feasibly be changed. This is so that all the effects of a development can be understood (for example the scale effects due to the proximity of a scheme, even if there is no scope to move the windfarm site). It is also important to identify and describe qualitative and quantitative effects and not just the latter because these may be easier to describe. In addition, the implications of quantitative data need to be explained, especially if there is not a direct relationship between the quantities and effects. |
| **Considering collective sensitivity or effects** | Although EIA and LVIA are not concerned with landscape and visual effects on individuals, it is nonetheless still important to assess the potential collective sensitivity or effects upon numerous individuals in an area as a group. For example, it was found through this research that people believed that the relative importance of scale effects from houses and gardens within an area as a whole were very high, even if these effects were not directly affecting them personally. |
| **Using the findings of assessment to inform siting and design** | The findings of scale assessment need to inform the siting and design of a proposal (the assessment process is not carried out just to describe the effects of a scheme as a *fait accompli*). Key aspects that scale assessment should inform are the number and size of wind turbines, the form of wind turbines, and their siting in relation to receptors (influencing proximity). It is important to consider a range of alternatives to be able to identify where the thresholds lie between different scale effects. Visualisations showing the various effects of different scales of development can inform this process. Changes to the different attributes will have varying effects, and reduction or increase in wind turbine sizes do not have equivalent effects as reduction or increase in wind turbine numbers. A key point to highlight is that, if the scale of a development results in significant adverse landscape or visual effects in just one aspect (for example wind turbine size *or* wind turbine numbers *or* proximity), then the scheme will invariably result in significant adverse landscape or visual effects. Numerous effects should not be averaged-out. |

## Appendix H.5: How can we site and design windfarms to minimise scale effects?

The following Table H.5.1 provides a provisional prompt list for siting and design of a windfarm to minimise adverse scale effects. This has been developed from the research findings described by chapters 5-7 of the thesis; nonetheless, the prompt list remains provisional because it has not been tested in practice and may require further development. At this stage, its primary purpose is to demonstrate how the findings of the research may be used in the future following further development.

As the siting and design principles included within the prompt list are based upon the research findings, it is expected that it may be necessary for the reader to refer back to chapters 5-7 for some explanations. For this reason, chapter, section and page references are provided in the three columns furthest to the right.

It is highlighted that the prompt list focuses upon issues of scale and thus, if carrying out other assessments such as a full LVIA, other landscape and visual issues would need to be considered. In addition, general guidance on windfarm siting and design would be relevant.

It is envisaged that the prompt list in Table H.5.1 would be used mainly by those carrying out professional assessment: either when involved with the design and LVIA of a proposed windfarm or, alternatively, reviewing an application for a proposed windfarm. Nonetheless, it could also be used by communities or members of the public to assess a scheme if they had good knowledge of the issues concerned.

Table H.5.1: Provisional prompt list in reference to the research findings for siting and designing a windfarm to minimise adverse scale effects[21]

| No | Siting and design principle | Ref to section in thesis | |
|---|---|---|---|
| | | Chapter | *Page* |
| **Spatial scale** | | | |
| 1 | Ensure that a windfarm does not seem overbearing in scale effect as perceived by people within the landscape. With regards to the windfarm attributes, this is most likely to be influenced by **proximity** to the windfarm, followed by **windfarm size** (number or extent of wind turbines) and **wind turbine size**. | 5 | 132-133, 137-138 |
| | | 7 | 188-189, 206-211 |
| 2 | Site and design developments to avoid overbearing scale effects upon the spaces in which they are located, but also upon the **spatial characteristics of the spaces from which they will be viewed**. | 6 | 163-164 |
| 3 | Site and design developments within landscapes where there would be **spatial separation between the viewers and the development**. This separation will be most clearly indicated by a change in landform, land-use or a landscape feature, but sufficient 'set-back' may also be achieved with intervening open space if the | 5 | 137, 139-140 |
| | | 6 | 163, 164-167 |
| | | 7 | 203-205 |

[21] Note: A windfarm that has some adverse scale effects will not necessarily be judged unacceptable in planning terms; this will depend on the policy test for acceptability. For a proposed development, these principles would need to be considered in combination with others that concern other landscape and visual effects.

| Table H.5.1: Provisional prompt list in reference to the research findings for siting and designing a windfarm to minimise adverse scale effects[21] | | | |
|---|---|---|---|
| No | Siting and design principle | Ref to section in thesis | |
| | | Chapter | *Page* |
| | extent of this can be perceived clearly (with distance cues). Conversely, avoid locating windfarms within open landscapes across which it is difficult to perceive distance, for example moorlands, if these are valued for qualities of openness, exposure and/or sanctuary but there is nothing to indicate spatial separation from a viewer. | | |
| 4 | For **wind turbine proximity, differences in scale effects** are greatest between being seen in the far distance and the middle distance, with reduced difference in scale effects between the middle distance and nearby. | 7 | 206-212, 219 |
| 5 | Site and design developments that do not seem **overbearing upon 'third-party' receptors**, such as people in nearby houses or settlements. | 5<br>7 | 137-138<br>157-158 |
| 6 | Site and design developments to avoid **overbearing scale effects on private spaces** (for example houses and gardens) and the perceived sense of refuge in these places, particularly if this would affect numerous individual places and thus would have collective effects within a community or area. | 6<br>7 | 157-159<br>196-198 |
| 7 | Ensure that a windfarm or windfarms do not seem to **surround receptors** and that there is a greater proportion of open windfarm-free space. This effect may be experienced from one location or sequentially whilst moving through a landscape. For private spaces, avoid developments being seen in multiple directions from the space. From routes, particularly those travelled slowly such as long distance paths, ensure cumulative effects are limited in duration/frequency. | 6<br>7 | 158-159, 163<br>200-201, 213-215 |
| 8 | For **windfarm size, the greatest differences in scale effects** are between a single wind turbine and a small cluster or between a medium-sized windfarm and a large-sized windfarm. In comparison, the difference between a small cluster and a medium-sized windfarm is not so great. Thus extension of a windfarm from medium to large size may have much greater scale effects than extending this from small to medium size. | 7 | 209, 211, 213, 219 |
| 9 | Ensure that wind turbines are not sited to **collectively create a spatial barrier** or edge that contrasts to a landscape or water expanse that is otherwise valued for its openness. | 5<br>6 | 520<br>166 |
| 10 | Site wind turbines so that they do not appear **upon steep hill slopes** that would mean they would seem visually unbalanced and overbearing upon the spaces below. | 5 | 142 |
| 11 | Do not locate a windfarm upon **the highest hills within a range**, nor on a site that is elevated above locations that people value within an area for their quality of feeling 'on top of the world'. | 5<br>6 | 134, 142<br>164-165 |
| 12 | Ensure that a windfarm is **surrounded by sufficient open space** for this to act as a buffer between the development and other landscape characteristics or viewers. Additionally, ensure that the windfarm does not appear to occupy the major proportion of open space or skyline visible within the landscape. | 5<br>6<br>7 | 132, 139-140<br>156-157<br>214-215 |
| 13 | Ensure that a windfarm does not seem to **cross or breach an edge** | 5 | 134, 140- |

Table H.5.1: Provisional prompt list in reference to the research findings for siting and designing a windfarm to minimise adverse scale effects[21]

| No | Siting and design principle | Ref to section in thesis | |
| --- | --- | --- | --- |
| | | Chapter | *Page* |
| | (which may be formed by hills) that is valued for defining an adjacent space. | <br>6 | 141<br>164-166 |
| 14 | Avoid siting a windfarm of a scale that will appear to **diminish the apparent scale** of an area valued for its perceived large extent. | 5<br>6 | 134<br>161 |
| 15 | Avoid wind turbines being seen (due to their proximity or scale) from **enclosed and/or sheltered landscapes** with qualities of sanctuary (from which it would not be expected that structures within adjacent landscapes would be seen). | 6<br>7 | 165<br>196-197 |
| **Visual scale and relationship to landscape characteristics or features** | | | |
| 16 | Ensure that a windfarm is not perceived as **overbearing upon landscape features or the landform** key to the character or value of the landscape or, alternatively, form an important visual backdrop to views. | 5<br>6 | 134, 139-141<br>166 |
| 17 | Aim to locate windfarm where this will be seen **separate from other vertical elements** in the landscape that may emphasise the relative vertical scale of the wind turbines. | 5 | 132-133, 135, 140 |
| 18 | Avoid conflict with a **distinct pattern of scale of landscape elements**, for example contrasting to a typical grading of large and small features at different elevations. Also avoid siting a windfarm within an elevated location that will diminish the qualities of elevation and scale of historic features within the landscape. | 5<br>6 | 140-141<br>161-162 |
| 19 | Aim for a windfarm to appear modest in scale in **relation to the scale of key landscape features**. This may be assisted by limiting the windfarm to appear one third or less in proportion of the visual scale of key landscape features with which it would appear associated, for example landmark hills, as an approximation of the Golden Section ratio. | 5 | 141-143 |
| **Experience of windfarm** | | | |
| 20 | Site a windfarm so that it is not **viewed at close proximity from below**, even if this allows partial screening of the wind turbines by landform or vegetation. A windfarm will tend to appear less overbearing where viewed typically from higher elevations. | 5<br>6<br>7 | 136, 138<br>161, 165<br>198-199 |
| 21 | Avoid locating a windfarm where it will be **seen during most activities** within an area on most days: ie where local people will feel there is no respite from seeing the windfarm. | 6 | 157-160 |
| 22 | Avoid a windfarm being visible where, as a result of its scale or proximity, it would seem to **intrude upon the type of activities** that are valued, for example enjoying a sense of sanctuary or tranquillity. | 6 | 158-160, 165-166 |
| 23 | Avoid wind turbines being **seen partially** due to screening. | 6 | 161-162 |
| 24 | Ensure that the vertical and horizontal scale of a windfarm relates to the apparent **scale of the landform** as experienced from different viewpoints within the landscape, including when seen in the middle and far distance. | 5<br>6<br>7 | 132-133, 139-140<br>156-157<br>198-199 |
| 25 | Avoid locating a windfarm where it would be **seen from a number of landscape character types** that are valued for being very different and distinctive and/or are used for different activities | 5<br>6 | 139-140<br>156-157, 159 |

| Table H.5.1: Provisional prompt list in reference to the research findings for siting and designing a windfarm to minimise adverse scale effects[21] | | | |
|---|---|---|---|
| No | Siting and design principle | Ref to section in thesis | |
| | | Chapter | *Page* |
| | and thus a windfarm would be seen as a unifying feature. | | |
| **Wind turbine design** | | | |
| 26 | For **wind turbine size, differences in scale effects** are greatest between being small size and medium size, with reduced difference in scale effects between medium size and large size in relation to different scale references. | 7 | 209, 211, 219 |
| 27 | Consider the **proportion of the wind turbines** in relation to a perception of overbearing scale effect upon the surrounding landscape and receptors. Design developments to avoid use of wind turbines with blades of longer length in relation to tower height. | 5 | 143-145 |
| | | 7 | 216-217 |
| 28 | Avoid **variation of wind turbine scale** so that smaller wind turbines are seen closer to a viewer than larger wind turbines, as this can confuse the perception of distance in relation to scale. In addition, avoid using wind turbines of contrasting scale, particularly rotor diameter, where these would be seen immediately adjacent or 'in front' of each other within a view as this will confuse scale reference. | 5 | 145 |
| 29 | Avoid the use of **wind turbine lights** that can be seen by the human eye from the ground. | 5 | 146 |

## H.6: How can we best carry out an assessment of the scale effects of windfarms in the landscape?

The following Table H.6.1 provides provisional notes for carrying out experiential landscape assessment for a windfarm, whether this is part of a LVIA or a separate study, including consultation and site assessment. These notes have been drawn from the research findings described by chapters 3-7 of the thesis, concerning both development of methods of assessment and the subsequent findings from these. Nonetheless the notes remain provisional because they have not been tested in practice and require further development. Thus, at this stage, their main purpose is to demonstrate how the findings of the research may be used in the future to assist assessment of how the landscape is experienced and scale effects (which was found to be inadequate within the LVIAs reviewed for this research).

As the notes in Table H.6.1 are based upon the research findings, it is expected that it may be necessary for the reader to refer back to chapters 3-7 for some further explanation.

It is highlighted that the notes are for experiential landscape assessment focused upon issues of scale and scale effects. Thus additional issues would need to be considered for other types of assessment.

It is envisaged that the notes in Table H.6.1 would be used mainly by those planning a professional experiential landscape assessment or, alternatively, reviewing an assessment completed by others for a proposed windfarm. Nonetheless, they could also be used by communities or members of the public to assess a scheme or review an application if they had good knowledge of the issues concerned.

Table H.6.1: Provisional notes for planning an experiential landscape assessment of scale effects and the experience of the landscape (within LVIA or separate) involving both consultation and professional assessment

| *No* | *Questions to address* | *Explanation* |
|---|---|---|
| 1 | What are the relative roles of professionals' assessment and consultation? | There is overlap between a professional's assessment and a consultation exercise and each inform the other. This research found that the professional assessment was good at identifying the nature of the key characteristics and qualities of the landscape and, complementing this, the information received through consultation explained better how and for what these characteristics and qualities were experienced and valued by different people (including affordances).<br><br>Professional assessment is required in advance of a consultation exercise, so that the assessor/ facilitator has a good familiarity of the area, can assist provision of information by participants, and can also interpret the information received 'on the spot' that helps to facilitate further discussion. Additional professional assessment is also required after a consultation exercise is complete to consider in further detail information raised by participants, for example to assess certain routes or places highlighted by people as being important. |
| 2 | What should be | The extent of the study area should be determined primarily by where |

| Table H.6.1: Provisional notes for planning an experiential landscape assessment of scale effects and the experience of the landscape (within LVIA or separate) involving both consultation and professional assessment | | |
|---|---|---|
| *No* | *Questions to address* | *Explanation* |
| | the extent of the study area for assessment? | there is likely to be significant effects in relation to the proposed development (following the same test as EIA). To identify this area, it is necessary to consider how and by whom the landscape tends to be experienced, influenced by the distribution of settlements, routes and vantage points from which a proposed development is likely to be seen. This can be established through background research and consultation with the local authority, community councils and through public advertisement. This should also capture areas of interested participants that might not have been obvious from preliminary assessment. Following this process, the geographical area identified for the study area is highly unlikely to form a circle surrounding the site, but will alternatively be irregular in shape on a map and may include outliers. |
| **Consultation** | | |
| 3 | Who should be consulted and when? | Past research has generally found it to be best to carry out consultation as early as possible during the planning process, partly so that the information provided can be incorporated within the siting and design process from the start. Nonetheless, there can be downsides to this, for example involving people with a potential scheme that is found to be unfeasible through the findings of the early EIA and thus their input was unnecessary. In addition, many developers are concerned about commercial confidentiality at an early stage of development. It also tends to be more difficult to engage in consultation with the general public when there is not a specific proposal (supported by the findings of this research for case study C), partly because there is nothing tangible to consider, but also because the unknown can prompt feelings of threat. In addition, some people will only get involved if and once they are particularly concerned, so it can be challenging to attract people with a range of attitudes at an early stage, both positive and negative. Conversely, engaging professionals at an early stage, such as local planning and SNH officers, is usually easier and productive, although these people too may have to limit their time input at an early stage due to prioritisation of their workload.<br><br>To engage people in consultation, it is useful to highlight what they can contribute, how this will be useful, and what it will lead to. In this respect, it was found through this research that it was useful to send an interim report of the findings and invite people's comments. Some studies have organised events to attract local people that are attached to the consultation, for example a cake competition and temporary radio station (Haggett, Coleman and Hodges, 2015): something to encourage people to come along to an event and get involved and for them to think that it will be worth their time whatever the usefulness of the consultation aspect. It has to be borne in mind that some communities are faced by numerous consultations or feel their contribution in the past has not achieved a great deal, so there can be some consultation fatigue.<br><br>The starting point for deciding who should be involved is considering the most appropriate scale for participation and those that are likely to be significantly affected by a development (SNH and The Countryside |

| Table H.6.1: Provisional notes for planning an experiential landscape assessment of scale effects and the experience of the landscape (within LVIA or separate) involving both consultation and professional assessment | | |
|---|---|---|
| *No* | *Questions to address* | *Explanation* |
| | | Agency, 2002b). This will include local people, but also others such as those that visit the area from further afield, for example partaking in recreation. These are distinguished as the 'communities of place' and the 'communities of interest' in SNH and The Countryside Agency's Topic Paper 6 (2002c). One approach can be to think about who will benefit or be disadvantaged by a scheme, with a suggestion that this may be at a national level for some development types such as large offshore windfarms (Rudolph, Haggett and Aitken, 2015), but any consultation obviously needs to be kept in proportion to be manageable and meaningful.<br><br>Within the study area, it is useful to consult both professionals and the public working[22] and living in the area. The first points of contact can be the council, SNH and community councils, not only to make contact with them directly, but to ask them who else they recommend should be contacted because they would have a potential interest in the scheme. In addition, as many of these have limited time availability, it would also be advisable to advertise the study and invite interest. It should be highlighted that there may be many Community Councils within a study area but, unfortunately, there may also be some areas that are not represented by a Community Council at certain times (for example because insufficient people stood for election).<br><br>It should be appreciated that there may be various social sensitivities surrounding certain consultations, for example due to the relationships between people in a community and a landowner for a proposed development, which means some people may feel they cannot be completely open with their views.<br><br>Alongside this consultation, there will be a statutory consultation process as part of the planning for a development proposal, for which different groups are consulted in different ways at different stages. Thus it needs to be considered how the findings of this study can input this process, for example by informing a response from the community council as well as informing the EIA. |
| 4 | What questions do you ask during consultation? | A range of questions are required for semi-structured interviews during consultation. These ensure key topics are covered and provide prompts to keep discussion 'on track' and proceeding when there are pauses. A key requirement is that the questions should not be leading. At a most basic level, the questions need to address: for what, how, who and why do people experience the landscape?<br><br>It is useful if the main structure of questions includes follow-up questions that can be asked if useful or required. For example, you might start with '*where do you go to experience the local landscape*?' but, if somebody cannot pick-up from this, you might add as examples: *if you are walking* |

[22] Not just if their place of work is within the study area, but also if their work applies to the area

| Table H.6.1: Provisional notes for planning an experiential landscape assessment of scale effects and the experience of the landscape (within LVIA or separate) involving both consultation and professional assessment | | |
|---|---|---|
| *No* | *Questions to address* | *Explanation* |
| | | *the dog, going out with a friend at the weekend, taking your children for a walk or taking a visitor to the area?*<br><br>Table D.4.2 of Appendix D.4 shows the structure of questions used for this research, but other questions could be more appropriate, depending on the particular issues of a scheme or an area. Generally, it is advisable during the consultation to first establish the baseline characteristics and qualities prior to raising issues concerning how the landscape is changing and/or what the potential effects would be of a proposed development on the key characteristics, qualities and value of the landscape.<br><br>When assessing scale in the landscape, it needs to be appreciated that people have different starting points for considering scale, for example the biologist may be looking at the detail of plants, whilst the engineer is looking at the broader landform. |
| 5 | What is the best format for consultation? What tools are useful? | The best format for consultation will usually be that which suits participants best, for example individually or as a group, at a participant's home, in a local café or community hall, or on site. It was found through this research that there are pros and cons of meeting people in groups. A key advantage is that participants of a group may be encouraged and informed by others so they offer more information, but a disadvantage is that it is more difficult to arrange an event for which a number of people need to be available at the same time, and some people may be more intimated by a group situation. For this research, it was found that group meetings with up to six participants were best (excluding the researcher), being small enough to allow good communication between all participants. To ensure participation and engagement by everyone, it was found that it was useful to 'go around the table' for the semi-structured questions, even if some members participated greater during subsequent open discussion.<br><br>The findings of the consultation can be recorded in different ways, depending on how the participants find it easiest to convey information. It is important to engage people at the level that is most relevant to the proposed development, but also with what people are most familiar, which may involve switching between scales of reference such as maps at different scales. During this research, it was found difficult to encourage people to mark on maps directly (possibly because of the particular difficulties of annotating aspects of scale at various levels on a two-dimensional sheet) and they found verbal discussion whilst pointing to maps more comfortable. Nonetheless, this could be different for different people and for a different project at a different scale of reference. A key requirement is to facilitate participants' understanding and articulation of issues, but this does take time and patience, with some participants picking-up the topic very promptly, whilst others will gain understanding and confidence following longer involvement.<br><br>During the consultation event, it is important for communication to be |

| Table H.6.1: Provisional notes for planning an experiential landscape assessment of scale effects and the experience of the landscape (within LVIA or separate) involving both consultation and professional assessment | | |
|---|---|---|
| *No* | *Questions to address* | *Explanation* |
| | | clear and comprehensible, the facilitator explaining what is meant by any technical or ambiguous terms used. It can be useful to have maps and images as tools to facilitate feedback and discussion. On site, it may also be useful when assessing scale effect to have visualisations showing a proposed development at different sizes, numbers or layouts, although the limitations of these images to depict scale needs to be explained |
| 6 | Who should carry out the consultation? | Consultation for a planning application is usually led by developers or their consultants, but this does not necessarily need to be the case and a study could be run by a council, SNH or community council. A key limitation will be the availability of time and funds. A developer usually has more resources available, but participants may be concerned about their motives. Instead, it may be best for independent consultants to carry out a consultation (albeit funded by the developers) if these are impartial, perhaps guided by a steering group that includes other parties. |
| **Professionals' assessment** | | |
| 7 | What experiences of the landscape need to be assessed on site and how? | The key objectives of experiential landscape assessment, whether this is part of LVIA or a stand-alone assessment, is to assess for what, how, who, where and why people experience the landscape. Table D.4.1 in Appendix D.4 sets out the different attributes that were assessed for this research under the four categories of: distribution and relationship between landscape character, settlements, residences and routes from which the landscape is experienced; activity of people within the landscape; spatial characteristics and the experience of these; and visibility, legibility and references within the landscape. These categories could be modified or supplemented to reflect the particular issues of a specific project.<br><br>The findings of this research revealed that, to assess the scale of a landscape and potential scale effects, it is vital to assess the landscape outside 'in the field' across the study area (not to refer mainly to maps and visualisations). Furthermore, when assessing a landscape in the field, it is important to assess places far beyond where may be convenient to access with a car. Through the assessment, the assessor needs to consider from where, how and for what people experience the landscape. This may require various modes of travel through the landscape, usually driving and walking, but possibly also others such as by train, bike, ferry or boat.<br><br>Whilst carrying out site assessment, in addition to recording in writing the attributes assessed at sample waypoints, it may be useful to produce sketch diagrams that highlight key elements of the landscape relevant to scale and/or its experience, for example scale and distance references (as these are unlikely to be represented clearly by site photographs). To inform the site assessment of the potential effects of a development, it will be useful to refer to maps and visualisations as tools. For example, computer-generated wireline diagrams showing different scales of a proposal from a range of representative viewpoints may be useful, although the limitations of visualisations need to be borne in mind. |

## Appendix H.7: Provisional prompt list to assess scale effects and the experience of the landscape

The following Table H.7.1 provides a provisional prompt list with questions to address when carrying out or reviewing an assessment of the sensitivity of a landscape to scale as well as potential scale effects of a proposed development. The issues raised in this table have been drawn from the research findings, particularly for the LVIA and experiential landscape assessment described in chapters 5-6. Nonetheless, the prompt list remains provisional because it has not been tested in practice and requires further development. Thus, at this stage, its main purpose is to demonstrate how the findings of the research may be used in the future to assist assessment of scale and scale effects. It is envisaged that this prompt list would supplement other guidelines such as GLVIA (Landscape Institute and IEMA, 2013).

The questions within the prompt list were identified following comparison between what was included in past LVIA reports (section 5.2) and scale issues that this research identified as being important to assess. This includes identifying the sensitivities of a landscape to scale effects and how these may be experienced by different people (section 5.3).

As the information in Table H.7.1 is based upon the research findings, it is expected that it may be necessary for the reader to refer back to the thesis for some further explanation.

It is highlighted that the notes are for assessment focused upon issues of scale and scale effects. Thus additional issues would need to be considered for other types of assessment, including a full LVIA.

It is envisaged that the prompt list in Table H.7.1 would be used mainly by those carrying out professional assessment, although it could also be used by members of the public to assess a scheme if they had good knowledge of the issues concerned. In contrast, it is envisaged that the subsequent simplified prompt list in Table H.7.2 would be useful mainly for members of the public.

| Table H.7.1: Provisional prompt list (detailed) for assessing the sensitivities of the landscape and visual resource to scale (including the experience of the landscape) and assessing the scale effects of a proposed development | |
|---|---|
| Question | |
| **Experience of the landscape (including affordances)** | |
| 1 | How do different **landscape types combine** within an area and how are these experienced? Which areas have a distinct identity or sense of place? Is the proposed development within a different landscape type from other locations from which it will be viewed? Where is it located in relation to the core or edges of landscape types? What are the different landscape contexts in which it will be seen? |
| 2 | Where do people travel through the landscape and where do they spend time in one place? What is the relationship between these **routes and places** with areas of open space, such as their position and density? Are they located around the edges of open spaces, or on one edge, or located within the middle? Does the distribution or nature of routes influence perception of distance through the landscape? |
| 3 | What are the differences of landscape experience that contribute to the **composite of experience** within an area that is valued? With regards to the representative viewpoints, is there assessment of how the characteristics these represent will be experienced together sequentially, in different combinations, at different times and by different people? |

| Table H.7.1: Provisional prompt list (detailed) for assessing the sensitivities of the landscape and visual resource to scale (including the experience of the landscape) and assessing the scale effects of a proposed development | |
|---|---|
| Question | |
| 4 | How do different **people use the landscape** and why? Is there assessment of how the landscape will be experienced by the same people carrying out different **activities** at different times for different purposes? Conversely, is there also assessment of how the landscape will be experienced by different people? How does activity in the landscape vary in different weathers or seasons? |
| 5 | Where and how do people go to experience the landscape within the local area and where are the **places they value**? For example, is there assessment of local vantage points, where people get-together for local events, the routes of walks, runs, cycle-rides or horse-rides (which may be along paths or off-path and/or may be along local rural roads)? Is there assessment of the **frequency by which people experience** different places, for example activities every day, twice a day, on the weekend, during week days? Are there places people go to experience specific emotions, for example excitement or a sense of tranquillity or sanctuary? |
| **Spatial scale characteristics** | |
| 6 | What are the **ranges, distributions and combinations of spaces** within the landscape, including the **scale of spaces** and perceived enclosure? For example: small, enclosed spaces within a glen floor adjacent to wide open spaces upon a plateau; or open moorland next to an open sea or loch; or agricultural enclosures upon hill slopes adjacent to extensive forest. |
| 7 | How are different **spaces defined or edged**? Do the edges seem impenetrable? Are the spaces encircled/ contained? |
| 8 | How are different **spaces juxtaposed**, for example one accentuating the qualities of the other in its contrast, including as a visual backdrop or buffer? Are the divisions between spaces abrupt, gradual or with different tiers (defined not just by boundaries, but also changes in ground cover, pattern or slope)? |
| 9 | What **qualities of different spaces or behavioural responses to these are valued by people** within an area, for example perceptions of exposure, refuge, escape or sanctuary? |
| 10 | What is the relative **elevation of spaces** in relation to their extent and edges and what perceptions are prompted by these characteristics, for example a sense of being 'on top of the word' or being hidden within a safe haven? What will be the elevation of viewers in relation to a proposed development? |
| 11 | What is the **proportion of land to sky** experienced within the spaces, such as having expansive skies or being surrounded by steep and high landform slopes or vegetation? |
| 12 | What is the occurrence and distribution of **foci within spaces** within the landscape, for example concentrated or dispersed, and do these provide spatial reference (such as 'landmarks') and contribute to the sense of place? |
| **Range and description of scale effects** | |
| 13 | Are **both visual scale effects and spatial scale effects** assessed, and is there consideration of how these effects will be experienced by people within the surrounding landscape? In addition, is there consideration of how people will perceive scale effects on others within the landscape (as an indirect 'third party' effect)? |
| 14 | Is there **definition of the different words used to describe scale** in the landscape, for example 'a large-scale landscape'? Separately, is there definition of what is meant by different levels of sensitivity of scale effect, different levels of magnitude of scale effect, and different levels of significance of scale effect? |
| 15 | Have the scale effects identified been **described clearly and explicitly**? Have they been checked to make sure they refer specifically to scale and are not confused with other characteristics such as prominence? |
| 16 | When making **reference to dimensions/ quantities**, is the scale effect also explained (as scale effects are not directly proportional to distance, size and number of an element)? |

| Table H.7.1: Provisional prompt list (detailed) for assessing the sensitivities of the landscape and visual resource to scale (including the experience of the landscape) and assessing the scale effects of a proposed development | |
|---|---|
| Question | |
| **Visibility, visual perception and visual features** | |
| 17 | Is there consideration of how people's views of scale in the landscape would be affected by **methods and cues for visual perception**? For example: atmospheric scattering; occlusion; linear perspective; textural perspective; scale constancy; object recognition; size contrast; and an impression of depth from motion parallax. |
| 18 | **From where will the proposed development be seen** and from where will it not? How will visibility and judgement of scale effect be influenced by screening, such as by the landform or woodland? Does screening mean that some parts of a landscape are not seen, for example seeing the foreground and distance, but not the mid-ground in-between? If a proposed development is partially screened, will people be likely to **recognise it as a specific object and thus predict its scale** (including as learnt from seeing it from alternative viewpoints)? |
| 19 | Which features or elements within the landscape are used as **reference points** and/or **visual scale or distance cues**? Are some important foci or landmarks? What is the distribution of these, for example within the fore, mid and background of views? Are they seen across the area that extends in-between key receptors and a proposed development? |
| 20 | Is there assessment of not only what would be seen within the landscape, but **what would be obvious**, considering the difference between what we see and what we notice? |
| 21 | Are there parts of the landscape with no scale or distance cues whose scale is **unclear and/or seems infinite in scale**? |
| 22 | Does the landscape have a vertical, horizontal, diagonal or mixed **emphasis in dimensions** of visual elements? How is **vertical scale judged differently to horizontal scale** within the landscape and what are the different cues used to perceive these scales? |
| **Landscape change** | |
| 23 | What are the main **changes in the landscape** that have occurred and are continuing to occur, and how are these likely to change the experience and value of the landscape by different people? |
| 24 | As part of the assessment of how the proposed development would affect the key characteristics or qualities of the landscape and visual resource, is there assessment of how the proposed development would affect the **experience of the key characteristics and qualities** and/or the behaviour/ activities of people? |
| 25 | How would the effects of the proposed development be different if it was **of different scale**? |
| 26 | How would the effects of the proposed development be different with a **reduced/ greater extent of the windfarm** (including larger or smaller number of wind turbines and/or at different spacing)? |
| 27 | How would the effect of the windfarm be different if it was sited at **alternative proximity from key receptors?** |
| **Wind turbine design and associated infrastructure** | |
| 28 | What are the **proportions of the wind turbines** being proposed in terms of rotor diameter to tower height and width? What would be the differences of scale effects of having wind turbines with longer or shorter wind turbine blades in relation to their towers in the landscape in which the windfarm is proposed? How is this influenced by the landscape pattern, spatial separation, the landform and/ or the elevation from which the wind turbines would be viewed? |
| 29 | How fast would the **wind turbine blades rotate** and how would this influence the experience and value of the spatial characteristics within the surrounding landscape, for example from where there may be a sense of enclosure, refuge or tranquillity? |
| 30 | What is likely to be the most frequent **orientation of the wind turbine blades and nacelle** and how does this relate to the location of visual receptors? |
| 31 | What **associated infrastructure** is proposed with the windfarm, for example: tracks; |

| Table H.7.1: Provisional prompt list (detailed) for assessing the sensitivities of the landscape and visual resource to scale (including the experience of the landscape) and assessing the scale effects of a proposed development | |
|---|---|
| Question | |
| | anemometers; lights; transformers; a substation; power lines? How will these affect the perceived scale of the landscape and how it is experienced, including as scale and distance cues? How will they influence perception of the scale of the individual wind turbines as well as the windfarm as a whole? |
| 32 | What will be the **colour** of the proposed wind turbines and will this be consistent for all the wind turbine components (apart from contrasting to external transformers)? How will this contrast to the land, sky or water backcloth seen within the range of views from across the study area (influencing 'figure-ground')? |

| Table H.7.2: Provisional simplified prompt list for consideration of the scale effects of a proposed development (envisaged for use mainly by members of the public) | | |
|---|---|---|
| *Question* | | |
| 1 | From where would you be likely to see the windfarm? | |
| 2 | How frequently would you be likely to see the windfarm? | |
| 3 | During what activities would you see the windfarm? | |
| 4 | What scale effects do you think the windfarm would have in terms of being overbearing: | |
| | a | On you, personally whilst you are in the surrounding area, either moving through this, visiting places, or located within a building, house or garden? |
| | b | On other visual elements that you can see in a landscape and think are important, such as buildings, fields, woodland, historic features? |
| | c | On spaces within the surrounding landscape, for example affecting the sense of enclosure, exposure, shelter or sense of retreat? |